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A PARTIAL REVISION OF THE GANODERMA APPLANATUM GROUP, WITH PARTICULAR REFERENCE TO ITS ORIENTAL VARIANTS

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THIRTY-SIX PLATES AND ONE TEXT FIGURE

INTRODUCTION

Of the wood-destroying fungi none are more common or more cosmopolitan than members of the *Ganoderma applanatum* group, and none show a greater degree of variation from country to country, or even within the limits of a prescribed country. Many specific names have been applied to variants within the group but the characters have often not been sufficiently marked and constant to permit the student of taxonomy to apply them

* The manuscript was entirely prepared by the senior author, who accepts full responsibility for the ideas presented and the data reported. The junior author gave invaluable assistance, however, in working out and recording the microscopic details that are so essential to the interpretation of relationships. She also aided in the tabulation of data, took practically all the photomicrographs of spores, and prepared and supervised the photomicrographing of the free-hand sections showing structure.

To the personnel of the photographic division we are much indebted for patient and courteous service in the preparation of the large number of illustrations, and we are also indebted to the artist, Mr. Macario Ligaya, and his assistants for the tedious task of mounting the thirty-six plates.

with any consistency when large representative collections are brought together from various parts of the world.

Only a cursory examination is necessary for the recognition of the group, since the members have many points in common. The principal distinguishing characters heretofore used in their segregation have largely been such superficial differences as color of the upper surface, form, and thickness of the context, and these are undoubtedly considerably influenced by habitat, climate, and available food supplies. This is likewise true of other wood-destroying groups of world-wide distribution. The genus *Ganoderma* is particularly plastic, however, and this has led to the creation of species where only well-marked varieties or forms are indicated.

Since the group is cosmopolitan it must be studied from the standpoint of its world distribution, as well as its regional. Until one reaches the Tropics few difficulties of interpretation are encountered. In the temperate regions the variations are comparatively minor but the great range of climatic conditions in the Tropics produces a multitude of forms grading one into the other to present a continuous series, the extreme forms of which are readily separable, the intermediates being subject to purely individual interpretation without distinct and consistent features by which to segregate them as species.

While the species-concept in mycology is, admittedly, to a certain extent a matter of individual interpretation, in general, the more material one studies from different parts of the world the broader those concepts become. Variation is but one of the steps in evolution and is normal to all plant life. Progressive variations when they become sufficiently distinct from the recognized type become at best varieties. The principal aim of mycology is to show relationships and, in the opinion of the writer, this can best be accomplished by linking the variations to the base species. The lesser variations (forms) are hardly worth considering from the standpoint of nomenclature, since to be consistent in this respect in a highly plastic group one would need to establish so many forms they would become burdensome and accomplish no useful purpose. From the angle of herbarium practice, where species within the genus are usually arranged alphabetically, the recognition of certain specimens as varieties would automatically place them in their proper position of relationship.

The present investigation was undertaken with the object of determining the range of structural differentiation in the variants already set up as species, in the hope that the microscope would bring to light sufficient fixed characters to allow of a rational segregation. The results obtained are not favorable to close segregation within the group. Appearances, and not definite relationships, have played too great a part, and even these have failed to establish anything sufficiently consistent to be applied by the working mycologist.

The treatment followed in the present paper will, therefore, deviate from past usage principally in reducing several so-called species to varieties or their regrouping under an even broader varietal concept than that originally set up for the species. Such varieties are based in part on spore differentiation and in part on general characters.

HISTORICAL

The genus *Ganoderma* was established by Karsten in 1881 [1] for stipitate polypores with a laccate pileus and stipe, *Ganoderma lucidum* (Leys.) being cited as the only member of the new genus; leaving *Ganoderma applanatum* in *Fomes*.

In 1889 he [2] gave the following generic diagnosis: "Basidia 4-spored, subglobose. Cystidia inconspicuous. Spores ovate or elliptical, verrucose, yellowish-brown" (Translation by M. C. Jensen).

In this same paper (p. 333) Karsten erected the genus *Elfvingia*, citing only *Fomes applanatus* (Pers.) Karst. His characterization of this genus is translated as follows:

"Pileus covered with a brittle crust-like membrane, smooth. Cystidia inconspicuous. Basidia subglobose, 4-spored. Spores ovate, warty, yellowish-brown."

Murrill [3] accepted this latter genus but placed with the four brown-spored species, now put in *Ganoderma*, two *Fomes* species with white, smooth spores; namely, *Fomes fomentarius* (L.) and *Fomes fasciatus* (Sw.) (*marmoratus* Berk.).

[1] Enumeratio Boletinearum et Polyporearum Fennicarum *in* Rev. Mycol. 3 (1881) 17.

[2] Krit. öfvers. af Finlands Basidsvampar 327.

[3] The Polyporaceae of North America—IV. The genus Elfvingia, *in* Bull. Torr. Bot. Club 30 (1903) 296.

Patouillard [4] in 1889 presented a partial outline monograph of the then known representatives of *Ganoderma* in which were included the members of the *applanatum* group. This classification has been followed by the principal European mycologists and also by many of the American. Lloyd [5] recognized the genus as section *Ganodermus* of *Polyporus*.

The distinguishing characters of the genus are the obovate, usually apically truncate, yellowish-brown to brown spores, with darker radial striæ in the walls, and the presence of a crust of varying degrees of hardness, this being laccate in most of the softer species. The *applanatum* group, however, rarely shows a specimen with the upper surface varnished even to the slightest degree. The laccate crust, therefore, cannot be considered an essential character and this leaves as the real diagnostic features the peculiar spores.

The members of the *applanatum* group have often been, and still are, placed by some in the genus *Fomes*, which they resemble in their firm to woody consistency and their frequently perennial habit of growth. The characters above outlined, however, are sufficient to make them congeneric with *Ganoderma*, although it would probably be advisable to place them in a separate section from the typical laccate species.

White [6] states that spore fall in *Fomes applanatus* under the climatic conditions of Ontario, Canada, begins early in May, when the tubes are about $\frac{1}{16}$ inch in length, and continues quite uniformly until the first heavy frost in late October or early November. While no observations have been made on these points in the Tropics, it has been noted during the course of the present investigation that certain specimens, particularly of variety *philippinense*, are quite devoid of spores, or possess them only sparingly, when the pores are even 1 centimeter long. Fritz [7] describes and illustrates cultures of the fungus on different media and reports clamp connections, which are more numerous and conspicuous on Czapek's synthetic medium.

[4] Le genre Ganoderma, *in* Bull. Soc. Myc. Fr. 5 (1889) 64.

[5] Synopsis of the stipitate polyporoids (1912) 102.

[6] On the biology of Fomes applanatus, *in* Trans. Roy. Canad. Inst. (1919) 139–140.

[7] Cultural criteria for the distinction of wood-destroying fungi, *in* Proc. and Trans. Roy. Soc. Canada III 17 Sect. 5 (1923) 210–213, pl. 1, figs. 1, 6 (colored), pl. 8, figs. 55–58.

The spores of *Ganoderma* have a dark spiny endospore and a colorless epispore. Coleman [8] has carefully studied the development of the spore wall and states that after the spore takes on its definitive shape a line of rather coarse granules forms just inside the spore surface. Later these granules fuse into a continuous membrane, from which short projections grow out toward the epispore surface, ultimately reaching almost or quite to the surface of the spore.

In our studies, as will be seen from the numerous photomicrographs presented, we have noted that the usual condition is for the spines to reach entirely to the outside wall of the epispore. Also, the spines are just as commonly parallel sided as tapering. We, therefore, prefer to call them striæ rather than spines, as this is the general effect they produce when examined with an oil-immersion lens.

HOSTS OF GANODERMA APPLANATUM AND ITS VARIETIES

As would be assumed from its wide distribution, members of the group have been reported on many hosts in practically all parts of the world. They are common saprophytes on dead trees, logs and stumps, becoming wound parasites of living trees in some instances, in which case they attack the roots or the lower part of the trunk. In the United States Hedgcock [9] reports *F. applanatus* on thirty-four species of broadleaf trees in sixteen genera: *Acer* (4 species), *Alnus, Betula* (3 species), *Fagus, Fraxinus, Hicoria, Liquidambar, Liriodendron, Morus* (2 species), *Populus* (7 species), *Pyrus* (2 species), *Quercus* (6 species), *Robinia, Salix, Tilia,* and *Umbellularia.* Of coniferous hosts he mentions eight species in four genera: *Abies* (3 species), *Picea* (2 species), *Pseudotsuga,* and *Tsuga* (2 species).

In 1914 he added to this list *Abies balsamea, Acer rubrum, Betula lenta, B. nigra, B. papyrifera, Crataegus coccinea, Nyssa sylvatica, Populus alba, P. fremontii wislizeni, P. heterophylla,* and *Quercus pagodaefolia.* Farlow and Seymour [10] also list *Acer nigrum.* White [11] supplements the list with *Aesculus hip-*

[8] The structure of the spore wall in Ganoderma, *in* Bot. Gaz. 83 (1927) 48–60, pl. 5.

[9] Notes on some diseases of trees in our national forests, II. *in* Phytopathology 2 (1912) 75–76.

[10] A provisional host index of the fungi of the United States (1888–91) 166.

[11] Trans. Roy. Canad. Inst. (1919) 136.

pocastanum, Carpinus caroliniana, Gleditsia triacanthos, Populus alba, Populus nigra var. *italica, Pyrus aucuparia, Quercus velutina, Ulmus americana,* and varieties of cultivated *Prunus.* Baxter [12] adds *Morus rubra.*

The latest summary is that of Seymour [13] in which are given the following hosts for *applanatum* on the North American continent: *Acer macrophyllum, negundo, rubrum, saccharinum, saccharum, saccharum* var. *nigrum, spicatum; Acacia* sp.; *Aesculus hippocastanum; Alnus oregana; Baccharis halmifolia; Betula alba* var. *papyrifera, lenta, lutea, nigra, occidentalis, populifolia; Carpinus caroliniana; Carya* [*Hicoria*] *ovata; Crataegus coccinea; Eucalyptus* sp.; *Fagus grandifolia; Fraxinus americana; Gleditsia* sp.; *Liquidambar styraciflua; Liriodendron tulipifera; Morus alba, rubra; Nyssa sylvatica; Platanus occidentalis; Populus acuminata, alba, angustifolia, balsamifera, deltoides, grandidentata, heterophylla, nigra* var. *italica; tremuloides, trichocarpa, wislizeni; Prunus avium; Pyrus malus; Quercus agrifolia, alba, coccinea, emoryi, falcata, macrocarpa, palustris, velutina; Rhododendron* sp.; *Robinia pseudo-acacia; Salix fragilis, nigra; Schinus molle; Tilia americana; Ulmus americana; Umbellularia californica; Abies concolor, grandis, lasiocarpa, shastensis; Picea canadensis, engelmanni, rubra, sitchensis; Pinus strobus; Pseudotsuga taxifolia; Tsuga canadensis, heterophylla.* For *Ganoderma australe* he records *Artocarpus communis; Prunus occidentalis, Prunus* sp. (prune); for *Ganoderma lobatum, Quercus rubra;* and for *Ganoderma tornatum, Cocos nucifera; Quercus agrifolia.*

Boyce [14] considers *Ganoderma applanatum* second only to *Fomes pinicola* in the destruction of wind-thrown coniferous timber on the Olympic Peninsula, Washington.

The senior author has collected the fungus in America on many of the above hosts and in addition on *Fraxinus nigra, Quercus lobata,* and *Cocolobus* sp. In the mines around Ironwood, Michigan, it produces a very destructive decay of maple (*Acer*), birch (*Betula*), and hemlock (*Tsuga canadensis*) props, particularly those of *Acer saccharum.* In the coal mines near Seattle, Washington, it is also found on western hemlock props (*Tsuga heterophylla*).

[12] Am. Journ. Bot. 12 (1925) 567.

[13] Host index of the fungi of North America (1929).

[14] U. S. Dept. Agr. Techn. Bull. 104 (1929) 27.

In England Rea [15] reports it on beech (*Fagus*), oaks (*Quercus*), ashes (*Fraxinus*), limes (*Tilia*), and elms (*Ulmus*).

In France Bourdot and Galzin [16] record it on *Quercus, Populus, Robinia, Fraxinus, Juglans, Fagus, Prunus* (cherry), *Pyrus* (apple), *Corylus, Abies,* and *Larix.* Patouillard [17] reports it on the Judas tree (*Cercis siliquastrum*). In addition Nicolas [18] records *Carpinus betulus, Alnus, Acer dasycarpum, Aesculus hippocastanum, Tilia cordata, Pinus silvestris, Abies, Morus,* cotton, and palms.

In Spain Lazaro [19] reports it on buttresses of *Fagus, Quercus,* and *Fraxinus.*

In Flora Italica Cryptogama Pars I: Fungi, Fasc. 15, pp. 1009–1012, it is reported on various frondose trees, rarely conifers, with specific mention of *Morus alba* and *Fagus.*

Lind [20] finds it in Rostrup's herbarium from *Populus deltoides, Fagus silvatica, Tilia europaea, Salix alba, Corylus avellana, Pyrus communis,* and *Fraxinus excelsior.*

From Japan and Formosa the senior author has specimens collected from *Acer palmatum, Alnus formosana, Fraxinus* sp., *Quercus serrata,* and *Nephelium longana.* Hennings [21] also reported *Fomes australis* on *Zellkowa acuminata* in Japan.

In South Africa van der Bijl [22] reports *Ganoderma applanatum* on *Acacia mollisima, Albizzia fastigiata, Celtis kraussiana, Curtisea faginea, Olea laurifolia, Podocarpus* sp., *Pyrus communis,* and *Rhus laevigata.*

To these hosts are added *Cunonia capensis* and *Trichocladus* sp. in another paper [23] published the same year.

In a government report on plant diseases in northwest Africa published in 1921 Steeg [24] reports it from Algeria on the carob tree (*Ceratonia siliqua*).

[15] British Basidiomycetae (1922) 597.
[16] Hyménomycètes de France (1928) 611.
[17] Le genre Ganoderma, *in* Bull. Soc. Myc. Fr. 5 (1889) 67.
[18] Bull. Soc. Myc. Fr. 42 (1926) 190.
[19] Las Polyporaceos de la flora Española (1917) 90.
[20] Danish fungi as represented in the herbarium of E. Rostrup (1913) 383.
[21] Engl. Bot. Jahrb. 28 (1900) 268.
[22] South Afr. Journ. Sci. 18 (1922) 278–279.
[23] Kew Bull. Misc. Inf. 6 (1922) 178.
[24] [Gouvt. gén. Algérie] Exposé situation gén. Algérie (1921) 512–514; Exp. Sta. Rec. 49 (1923) 45.

Weir [25] found *australe* once as a wound parasite on *Hevea brasiliensis* in the Amazon Valley.

Cunningham [26] reports *applanatus* on fallen logs of *Podocarpus spicatus* and *Dacrydium cupressinum* in New Zealand, while *australe* is found on *Acacia dealbata, Coprosma lucida, Nothofagus fusca, N. menziezii, Podocarpus spicatus,* and *Salix babylonica.* He finds *subtornatus* on *Dacrydium* and *Podocarpus.*

The above list comprises over fifty genera and over one hundred species of trees for the temperate regions alone. When one considers the tropical and subtropical regions, with their thousands of species of trees on many of which collections of *Ganoderma applanatum* and its varieties or close relatives have been made, in numerous instances without identification of the host, the great variety of plants attacked by this ubiquitous wound parasite and saprophyte will be appreciated.

PARASITISM OF GANODERMA APPLANATUM AND ITS VARIETIES

While the fungus is usually found as a saprophyte on stumps and fallen and standing trunks it is recognized at times as a parasite that gradually invades the living sapwood after entering through wounds and becoming established in the heartwood.

In 1906, Heald [27] called attention to its attack on *Populus deltoides,* considering it a facultative parasite that is not able to attack young healthy trees but can become parasitic on older trees, whose vitality has become lowered, or those that have reached their maximum development.

Petch [28] states that a large *Zizyphus xylopyra* was attacked by *Fomes australis* at Peradeniya and that most of the old trees of *Acacia decurrens* at Hakgala were killed by the same fungus.

Butler [29] mentions a root disease of coffee associated with *Fomes australis* in Madras.

Petch [30] likewise reports the parasitism of *Fomes applanatus* on *Acacia,* coffee, and tea roots in Ceylon. His observations on the fungus as a cause of tea disease are summarized in Diseases of the Tea Bush (1923) 167–169.

[25] U. S. Dept. Agr. Bull. 1380 (1926) 17.

[26] Trans. N. Zeal. Inst. 58 (1927) 214–218.

[27] A disease of the cottonwood due to Elfvingia megaloma, *in* Nebr. Agr. Exp. Sta. Ann. Rept. 19 (1906) 92–100.

[28] Circ. and Agr. Journ. Roy. Bot. Gard. Ceylon 5 No. 10 (1910).

[29] Ann. Rept. Board Sci. Advice India 16 (1915) 110.

[30] Trop. Agriculturalist 59 (1922) 248.

Steinmann,[31] on the other hand, finds it almost exclusively saprophytic in the Dutch East Indies.

Kauffman [32] cites *Fomes applanatus* as occurring on living *Fagus, Fraxinus, Quercus,* and *Ulmus.*

Stewart [33] in 1918 found two large cherry trees in New York severely attacked.

Clinton [34] discusses the fungus in relation to ornamentals and says that it is occasionally found on living maples, poplars, willows, apples, and peaches.

Hubert [35] states that it sometimes occurs on box elder (*Acer negundo*) in association with the red stain caused by *Fusarium negundi* Sherb.

Meinecke [36] describes the rot that it produces in *Populus tremuloides* in Utah, but says that *Fomes igniarius* is of far greater economic importance in this species.

Zeller [37] observed the progress of root rot in prune trees in Oregon for two years where he found a large number of trees blown over while in full leaf and some in full fruit. All had the characteristic white butt rot of *Fomes applanatus.* About one and a half years later many other trees in the orchard bore fruiting bodies on the lower portion of the trunks and on the roots. These trees had a very loose footing. The infection was thought to occur near the base of the trunk, or on shallow roots, through wounds probably caused by cultivation machinery.

Cleland and Cheel [38] state that the appearance of brackets of *Fomes applanatus* at the base of a tree is a sure indication that vital processes are being interfered with. In the forests of New South Wales the fungus is common at the base of *Eucalyptus.* It is also reported as killing a tree of *Acacia horrida* at Sydney.

White [39] states that in eastern Canada living trees of almost all the common broad-leaved species have been found bearing sporophores of *Fomes applanatus,* the percentage being high in

[31] De Thee 7 (1926) 87; Rev. Appl. Myc. 6 (1927) 514.
[32] Nineteenth Ann. Rept. Mich. Acad. Sci. (1917) 151–153.
[33] N. Y. Agr. Exp. Sta. (Geneva) Bull. 463 (1919) 172–173.
[34] Conn. Agr. Exp. Sta. Bull. 263 (1924) 191.
[35] Journ. Agr. Res. 26 (1923) 449.
[36] U. S. Dept. Agr. Techn. Bull. 155 (1929) 5.
[37] Mycologia 14 (1922) 181.
[38] Disease in forest trees caused by the larger fungi, Forestry Commission N. S. W., Bull. 12 (1918) 10.
[39] Trans. Roy. Canad. Inst. (1919) 161.

some localities. A study of the disease in an apple trunk showed it to have progressed outward to the bark, involving the cambium. Other trees showed the sapwood invaded. His best argument for parasitism is the presence of a brown band of so-called wound gum and the development of abundant tyloses at the advancing margin of the decay, indicating that the tissue invaded is living. Direct proof of strong parasitism, however, was not forthcoming from several hundred inoculations in six species of healthy trees of different age classes.

Among the monocotyledons the oil palm (*Elaeis guineensis*) is attacked on a large scale in St. Thomas and Princeps Islands and the adjoining coast of West Africa. According to Maublanc and Navel [40] the trees become hollowed at the base for one-third to one-half the thickness of the trunk and to a height of a meter or more. Many of the hollow trees show no external signs and remain in full vigor and production. The palms that fall, however, are always more than 10 meters high.

In 1922 Coutinho [41] again reports it on *Elaeis* and also on *Cocos nucifera* in St. Thomas; da Camara and Coutinho further refer to it in 1925, while De Wildeman [42] reports *australe* on *Elaeis* from the Congo.

Small [43] mentions the fungus as a suspected parasite on coco palm. Von Schrenk and Spaulding,[44] considered *Fomes applanatus* as a sap-rotting organism. After discussing Heald's paper on the disease of cottonwood they state they are "not inclined to call this decay a disease in the sense in which the decays induced by *Fomes ignarius, F. fraxinophilus,* and others are diseases. There are a large number of species of fungi that, like *Fomes applanatus,* grow on dead wood, and that may now and then grow on living trees." They, therefore, considered it a saprophytic form.

[40] Sur une maladie du palmier à huile (Elaeis guineensis Jacq.) aux îles San Thomé et de Principe produite par un champignon (Ganoderma applanatum Pers.), *in* L'Agronomie Coloniale 5 (Année 4) (1920) 187–191.

[41] Anais do Inst. de Agron. [Coimbra] (1922); Rev. Appl. Myc. 2 (1923) 589; Anais do Inst. de Agron. [Coimbra] (1925) 138; Rev. Appl. Myc. 5 (1926) 149–150.

[42] Matières grasses 13 (1921) 5737; Rev. Appl. Myc. 1 (1922) 78.

[43] Yearbook Dept. Agr. Ceylon (1927) 7–10; Rev. Appl. Myc. 6 (1927) 273.

[44] Diseases of deciduous forest trees, U. S. Dept. Agr. Bu. Pl. Ind. Bull. 149 (1909) 58–60.

Hedgcock [45] followed this view in 1912, but in 1914 concluded that the fungus "very frequently attacks both the sapwood and heartwood of many living trees."

The evidence presented above, much of which has been corroborated by the senior author points clearly to its parasitic tendencies. The fact that young vigorous trees are not infected is no direct criterion of parasitism, since this is true of all the recognized wound parasites.

MATERIAL EXAMINED

The Philippine material examined is contained in the Bureau of Science herbarium at Manila and the Baker herbarium at the College of Agriculture, Los Baños, the latter being kindly placed at our disposal by Dr. G. O. Ocfemia. The Philippine Bureau of Forestry has also supplied a considerable number of specimens that will be deposited at the Bureau of Science. During the past four years the senior author has likewise made extensive collections for the Bureau of Science so that the material formerly available has been more than doubled. These later collections were always made with the object of securing all variations possible, from the youngest to mature, or even old, stages of development. They have thrown much light on existing relationships and have enabled us to interpret to better advantage the named specimens in the two herbaria.

There are very few extra-Philippine specimens either at Manila or Los Baños. The senior author's herbarium, however, contains considerable material from the United States, Brazil, Japan, and Formosa. Two specimens were secured from the acting mycologist, mycological division, Department of Agriculture, Peradeniya, Ceylon, in a collection of sixteen duplicates of polypores from that herbarium. From the Botanic Gardens, Singapore, E. J. H. Corner, Esq., assistant director, loaned us all their specimens of *Ganoderma,* among which were twenty-two specimens pertaining to the *applanatum* group. From the Botanic Gardens, Buitenzorg, Java, Mr. Beaumée, assistant director, furnished, on loan, one hundred twenty-two specimens of *Ganoderma* or other *Polyporaceae,* including twenty-one collections of the group under review. In addition Dr. J. B. Cleland has furnished the senior author from time to time with a good representative series from Australia. To these institutions and these gentlemen we desire to express our deep appreciation for the courtesies extended.

[45] Phytopathology 4 (1914) 185–186.

The Philippine specimens at the Bureau of Science and in the Baker herbarium have been named principally by Bresadola, Lloyd, Murrill, and Patouillard. These specialists are far from agreement in their species concepts as well as in their identification of the same specimens. The last revision of the Bureau of Science material was by Lloyd, with the result that certain packets bear three different specific names, those of Bresadola, Murrill, and Lloyd. The Los Baños material was largely identified by Lloyd and Patouillard, but apparently Lloyd did not revise any of Patouillard's work. Had he done so his concepts would certainly have differed from those of the French mycologist.

Unfortunately, many of the earlier collections preserved in the Philippines are limited in quantity and are often represented merely by a portion of a small specimen. Also a considerable number of the specimens reported by various writers are missing. Collectors for the Bureau of Science have also often been remiss in keeping separate the different individuals of a given collection, with the result that in a number of instances at least two distinct species of *Ganoderma* have been included in the same packet. In as much as the original collections have often been split up and distributed widely as duplicates it is quite probable that different herbaria have not always received the same species, variety, or form as in the original packet in Manila. In a few instances this has been found to be the case with supposedly duplicate specimens sent to the Baker herbarium at Los Baños.

In the course of the investigations approximately three hundred eighty collections within the group were critically examined and compared both microscopically and macroscopically. These came from the following countries: North America, 43; South America, 9; West Indies, 2; Canary Islands, 1; Europe, 4; Africa, 2; Australia, 14; New Zealand, 1; Dutch East Indies, 16; Ceylon, 2; Borneo, 4; Federated Malay States, 20; Amboina, 1; China, 3; Formosa, 5; Japan, 11; Philippine Islands, 250.

This is probably the largest series of specimens ever critically studied at the same time, one in comparison with the other, but there still remains much more to do both in the Philippines and in other of the less-explored regions before a complete rational monographic treatment can be accomplished. The present is but a stepping stone.

TECHNIC

All microscope measurements of hyphæ and spores were made with the 1/12a fluorite oil-immersion objective and 10x Huyghenian ocular, using a Leitz microscope, with a tube length of 160 millimeters, while colors of these elements were observed with the No. 6 (4 millimeter) objective and the same ocular. All photomicrographs of spores were made with the 1/12a oil immersion objective and 8x ocular. For each specimen ten representative spores in the crushed mount, or from the upper surface of the pileus, were measured and the average taken. Similarly, ten measurements were made of both the context and dissepiment hyphæ. Sometimes two or more specimens from the same collection were examined in this way, and very often the spores from the crushed mount and from the upper surface of the same sporophore were studied. All microscopic mounts were made in 7 per cent potassium hydrate. In the case of crushed mounts a generous fragment of pores was first saturated with the potash then cut up somewhat and pressed. Spores from the upper surface were removed in a loop of fine flamed platinum wire dipped in the potash solution. The former method naturally yielded considerable fine débris, which was objectionable in photographing; the latter method, which was followed whenever spores adhered to the upper surface, frequently gave nearly clean mounts. In the many comparisons made between spores from the crushed pores and those from the surface of the specimen they were always found to be the same, varying only in the latter being more mature and, therefore, usually being somewhat larger and darker colored. We have found the method so satisfactory that it is being applied to other species of *Ganoderma.*

In all, about 8,700 hyphal measurements and 4,700 spore measurements were made during the study; over two hundred photomicrographs of spores were taken. For the latter either the Zeiss "Maccam" or the small Bausch and Lomb camera was used. These have a fixed bellows length and yield very nearly the same magnification.

A few photomicrographs of somewhat higher magnification to show the structure of the crust and the dissepiments were taken on the large Bausch and Lomb horizontal camera, using a Zeiss microscope equipped with dry objective DD and ocular 4. These are all at the same magnification.

Pore surfaces of representative specimens were photographed through a 35-millimeter Zeiss Planar lens fitted to a Leitz microscope with 6x ocular and 160-millimeter tube length.

In addition to photographing the pores, representative specimens were selected to show variation in their size and shape and variation in thickness of dissepiments. The size was recorded in two ways; namely, by measuring the number per millimeter with a hand magnifier and celluloid millimeter scale, and by actual measurement of the diameter of the pores and the thickness of the pore walls under the low power of the microscope.

Colors were compared with those in Ridgway's Color Standards and Color Nomenclature, and all direct comparisons are indicated by (R) following the color name. It must be borne in mind, however, that spore colors as viewed through a microscope are very difficult to match and even color variations in the context or of the upper and lower surfaces of the sporophores cannot be reported with any great fidelity since the incidence of the light, the intensity of illumination, and the lack of exactly corresponding shades in the book all influence the results obtained. It is believed, however, that those recorded will offer a fairly close approximation and the ranges will give an idea of the variations to expect.

DISCUSSION OF DESCRIBED SPECIES

There have been a considerable number of specific names in current use within the group but their application has been far from consistent. Before a definite opinion concerning certain of them regarding their validity as species, varieties, or forms can be formed, however, it will be necessary to examine such of the types as have been preserved. Since there is no opportunity of doing this at present the only procedure that can be followed is to discuss them in the light of determinations and opinions expressed by other workers.

Fourteen specific names have been applied to *Ganoderma applanatum* or its variants in the Philippines; namely, *applanatum, australe, fasciatus, gibbosum, incrassatum, koningsbergii, leucophaeum, mastoporum, megaloma, nigro-laccatum, oroflavus, subtornatum, testaceum,* and *tornatum.* Such of the specimens so determined as are referable to the *applanatum* group at all are nothing but varieties or forms of the base species. The following comments are offered on those not treated under the later discussion of accepted species and varieties.

FOMES FASCIATUS LÉV.

Fomes fasciatus Lév. (bis), *Bureau of Science 28450* of Lloyd's determinations, is more closely allied to *Ganoderma mastoporum* (Lév.) than to *G. applanatum,* while *Bur. Sci. 28308* is a very young sessile specimen without pores that we have referred to *G. applanatum* var. *philippinense.* He has also named one specimen in the Singapore collections (*8354*) that is typical *tornatum.* Lloyd [46] discusses the fungus as follows: "With characteristic spores. It has a hard non-laccate crust, ungulate in shape, yellowish pore mouths and little context development, I should call it a form of Fomes australis. It is Fomes fasciatus in the sense of Léveillé and Patouillard, though as it was only a misdetermination of Léveillé I think the name has no validity as applied to this plant." Later [47] he states, "Surface dull, marked with pale and brown zones, otherwise as the form leucophaeus. The spores of our Java collections are none of them truncate at the base, the membrane seeming not so strongly developed as usual. This is a tropical form the name based on a misdetermination by Léveillé. We do not think that an acknowledged misdetermination has any validity as a name, but use it as we know no other for this form."

His last word on the subject [48] is this: "Certainly only a form of the polymorphic Fomes applanatus. It is what Léveillé called Fomes fasciatus (in duplicate) but these forms are hard to definitely name. It should be renamed if these forms were worth renaming."

There is one specimen (*1926*) in the Javan collections named by Patouillard (Plate 5, figs. 17 and 18). This is a young subungulate sporophore with a rather hard auburn context and a thin layer of young pores from which we could obtain no spores. It is sufficiently close to *applanatum* to be considered merely a variant.

Torrend [49] considers the fungus a variety of *G. applanatum.*

GANODERMA GIBBOSUM (NEES)

There are five Philippine collections referred here by Lloyd. Of these, *5110 and 19234* are typical sessile *applanatum* var. *tornatum, 9100* and *10534* are very young specimens without pores,

[46] Letter 38 (1911) 5.
[47] Syn. Gen. Fomes (1915) 265.
[48] Myc. Notes 71 (1924) 1242.
[49] Les Polyporacées du Brésil, *in* Broteria 18 (1920) 40.

which are better referable to *G. mastoporum*, and *Copeland 762* is the cotype of *Ganoderma incrassata* forma *substipitata* Bres. This latter appears close to *tornatum* but is not included in the present paper.

There are three specimens named *gibbosum* by Lloyd in the Singapore herbarium. Of these, one (*5385*) may be a small stipitate form of variety *philippinense*, another (*5518*) is *mastoporum*, and the third (*5384*) is an irregular form that we are unable to properly refer at present.

Lloyd [50] states that small stipitate Brazilian specimens sent him by Rick were referable here but that they are really *Fomes applanatus*. Later [51] he also reports in connection with Javan specimens from van Overeem, "This is the name applied to the polymorphic Fomes applanatus when it takes stipitate forms as it does in the tropics, but rarely in temperate regions. It is not a species." Junghuhn [52] merely gives Nees' description and states that the fungus had not been observed by him. Cooke [53] places it as a synonym of *Fomes amboinensis* Fr.

Bresadola [54] describes var. *pulchella* from Zollinger's collection from Java, stating that it differs from the type in its smaller size and smaller spores. The spores are given as smooth, 4 to 6 by 6 to 9 μ, while in typical *G. gibbosum* they are said to be 6 to 7 by 9 to 11 μ.

Patouillard [55] in his last posthumous work places the species as variety *stipitatum* of *Ganoderma applanatum*.

GANODERMA INCRASSATUM (BERK.)

This was originally described [56] from Cape York, Australia (*Challenger Exped. 141*). We find no further notes regarding it in the literature except that Cooke [57] reports *Fomes reniformis* Morg. as a synonym. If this were the case then *incrassatum* would become in turn a synonym of *lobatum* Schw. Lloyd [58] considers it the same as *leucophaeus*.

[50] Myc. Notes 59 (1919) 859.
[51] Myc. Notes 71 (1924) 1242; *see also* 67 (1922) 1165.
[52] Praemiss. Fl. Crypt. Javae Insulae (1838) 66.
[53] Praecursores ad monographia Polypororum, *in* Grev. 15 (1886) 55.
[54] Polyporaceae Javanicae, *in* Ann. Myc. 10 (1912) 501.
[55] Ann. Crypt. Exot. 1 (1928) 17.
[56] Journ. Linn. Soc. (London), Bot. 16 (1877) 41.
[57] Grevillea 15 (1885) 21.
[58] Syn. Gen. Fomes (1915) 281.

In his preliminary survey of the Polyporaceæ Murrill [59] says that when *reniformis* [*lobatum* (Schw.) Atk.] was first sent to Kew it was determined as *applanatum*. Later it was placed by Cooke under *incrassatus*. The specimen, however, was not in his opinion, representative of *reniformis*. This is perhaps what led Cooke to consider it the same as *incrassatus*.

Bresadola [60] based his new form *substipitata* on *Copeland 762*. In the Bureau of Science herbarium this is a small stipitate specimen with a blunt, nearly vertical, sulcate margin, which is rather close to *tornatum* but seems sufficiently distinct to maintain until further material is collected. In the Baker herbarium there is a sessile specimen with a rather acute margin under the same number.

There are in the Bureau of Science three specimens from J. A. Stevenson of which two (*1599, 1690b*) are from Florida determined by Weir as *G. incrassata* and *G. tornata,* respectively, and one from Porto Rico (*1480*) determined as *G. tornata;* also, the senior author has a section of a sporophore from the New York Botanical Garden collected in Florida and determined by Murrill. These are the same heavily laccate species but apparently are not *incrassatum*. The evidence at hand, therefore, is not sufficient to interpret *Ganoderma incrassatum* of Berkeley.

FOMES KONINGSBERGII LLOYD

The species was described [61] from an abundant collection from Java sent to Lloyd by Dr. J. C. Koningsberger. In the Bureau of Science there is a single specimen (*Flora of British North Borneo 2094*) so named by Lloyd. This is quite typical of what the senior author calls variety *philippinense* of *Ganoderma applanatum*. Among the Buitenzorg specimens there is one collection (*1619*) also named by Lloyd (Plate 20, figs. 9 and 10). This is sufficiently typical of what the senior author segregates as variety *tornatum* forma *macrospora*.

GANODERMA LEUCOPHAEUM (MONT.)

Described [62] from Ohio, collected by Sullivant.

[59] Bull. Torr. Bot. Club 30 (1903) 299.
[60] Hedwigia 56 (1915) 295.
[61] Syn. Gen. Fomes (1915) 270.
[62] Sylloge Generum Specierumque Cryptogamarum (1856) 157–158.

Patouillard [63] recognized it as a species growing in France and Bresadola has reported it from Hungary [64] and Africa.[65] Theissen found it in Brazil,[66] Cleland and Cheel in Australia,[67] and the senior author found it in Japan. These few references indicate that the form is practically coexistent with *Ganoderma applanatum.*

In his critical study of *Fomes applanatus* in the United States Atkinson [68] has conclusively shown that it is nothing but a variant of that species. Bresadola and Patouillard always maintained the fungus as a distinct species. Lloyd in his earlier writings [69] considered it distinct from *applanatum* but finally concluded [70] that it is "only a form of the common Fomes applanatus with a pale hard crust." Cleland and Cheel [71] place it as a variety of *applanatum.*

The senior author has collected *Fomes applanatus* in various parts of the United States over a hundred times and has observed it growing thousands of times, as it is very common particularly in the northern part of the country, and can affirm that the variation called *leucophaeum* is by no means extreme and hence readily falls within the species concept of *applanatum.* Many of the Philippine specimens in the Baker herbarium so determined by Patouillard the senior author would refer to *applanatum* var. *philippinense,* as they appear varietally distinct from any forms seen in the United States or from Europe. Lloyd's *leucophaeum* of the Philippines is largely referable to *applanatum,* although a few go into variety *philippinense,* while specimens so named in the Buitenzorg and Singapore herbaria are principally *tornatum.*

[63] Bull. Soc. Myc. Fr. 5 (1889) 73.

[64] Hymenomycetes Hungarici Kmetiani, *in* Atti dell. I. R. Acad. Sci. Let. ed Arti degli Agiati in Rovereto III 3 (1897) 66–117.

[65] Fungi Kamerunenses, *in* Bull. Soc. Myc. Fr. 6 (1890) XLI.

[66] Polyporaceae austro-brasilienses imprimis Rio Grandenses, *in* Denkschr. math.-nat. Kl., Kaiserl. Akad. Wiss. (Wien) (1911) 6 (of reprint).

[67] Proceed. Roy. Soc. N. S. W. 51 (1918) 518.

[68] On the identity of Polyporus "applanatus" of Europe and North America, *in* Ann. Myc. 6 (1908) 179–191.

[69] Myc. Notes 6 (1901) 60 (Note 135); Letter 10 (1906) 3–4; Letter 26 (1909) 4; Myc. Notes 33 (1913) 437.

[70] Myc. Notes 67 (1922) 1164; 71 (1924) 1242.

[71] Proceed. Roy. Soc. N. S. W. 51 (1918) 518; Trans. Roy. Soc. So. Austral. 47 (1923) 68; ibid. 48 (1924) 251.

GANODERMA MASTOPORUM (LÉV.)

This is a good but apparently highly variable species which forms the nucleus of a group sufficiently distinct from the *applanatum* assemblage. It has been given at least twelve different names in the Philippine collections; namely, *amboinense, applanatum, australe, balabacense, dorsale, fasciatus* Lév., *gibbosum, mangiferae, nigro-laccatum, testaceum, tornatum,* and *williamsianum.* The senior author considers *Ganoderma mastoporum* Lév. more closely allied to the true laccate Ganodermas and hence it is not described in the present paper. At one extreme of its variation it approaches forms of *applanatum* var. *philippinense.* It has essentially the same type of spore as this variety but is a much smaller species and strongly tends to stipitate or substipitate forms.

GANODERMA MEGALOMA (LÉV.)

This was described by Léveillé [72] from a New York collection at the Muséum d'Histoire naturelle de Paris. He states that it is close to *applanatum* in form, consistence, and size, but differs from it essentially in the color of the pileus, the pores, and especially in the margin, which forms on the lower surface a sterile band up to 0.5 centimeter wide. It is interesting to note, however, that *Fomes applanatus* from Ménand, New York, is listed in the same paper just preceding his new species.

Murrill [73] took up the specific name in 1903 and applied it generally to what is now considered *Fomes applanatus* of the United States. He continued this usage in the North American Flora (Polyporaceæ), 1908, the same year that Atkinson [74] had shown the identity of the two. Bresadola [75] maintained the species as *Ganoderma megaloma* (Lév.) Big. and considered *leucophaeum* a synonym. He cites two collections from the Philippines. One of them (*Bur. Sci. 10538*) the senior author would refer to *applanatum* var. *philippinense;* the other is not represented in the herbarium.

[72] Ann. Sci. Nat. II Bot. 5 (1846) 128–129.

[73] Bull. Torr. Bot. Cl. 30 (1903) 271.

[74] Ann. Myc. 6 (1908) 179–191.

[75] Hedwigia 53 (1912) 54; Synonomia et adnotanda mycologia, *in* Ann. Myc. 14 (1916) 225.

Lloyd [76] states that "no type exists and it is unknown" and made no use of the name.

There can be little question that the fungus is but a form of the variable *applanatum*. Atkinson [77] and White [78] both discussed the wide sterile band on the lower surface of the margin and showed that it is nothing specific in character. The writers would also place the species as a direct synonym of *applanatum*.

GANODERMA NIGRO-LACCATUM CKE.

Described by Cooke [79] from Mauritius. Bresadola [80] reported it from Kamerun in 1890 with the remark that the specimens examined closely resembled *Polyporus fuliginosus* Scop. (*benzoineus* Fr.) but differed in the glabrous nigro-laccate crust. Later [81] he placed the species in synonymy with *applanatum*, with the statement that there are two specimens in Herb. Kew from Mauritius under *2* (cited in the original description), one of which is *Ganoderma galegense* (Mont.). Lloyd [82] remarked in 1912, "For me a form of the common Fomes australis of the tropics, with a slightly laccate crust." Ten years later [83] he states, "quite different from Fomes applanatus in having a more or less black lacquer, it is still much closer to Fomes applanatus than it is to those of the lucidus group. We take it in the only logical sense of Cooke's name even if the author had no idea, however vague, of its identity." Cleland and Cheel [84] place it as a variety of *applanatum*. Cunningham [85] states that it "cannot be separated on any character from *F. australis*."

There are three specimens in the Bureau of Science and Baker herbaria determined by Lloyd, of which one (*Baker 9683*) is referable to variety *tornatum;* the other two are in the Bureau of Science (*14366* and *19084*). These are the same as two other specimens in the Baker herbarium, *898* determined *Ganoderma amboinense* (Lam.) Pat. by Patouillard and *9707* deter-

[76] Syn. Gen. Fomes (1915) 282–283.

[77] Ann. Myc. 6 (1908) 179–191.

[78] Trans. Roy. Canad. Institute (1919) 135, Pl. 2, fig. 1.

[79] Grevillea 9 (1881) 97.

[80] Bull. Soc. Myc. Fr. 6 (1890) XLII.

[81] Hedwigia 53 (1912) 55.

[82] Letter 39 (1912) 2.

[83] Myc. Notes 67 (1922) 1165; *see also* Syn. Gen. Fomes (1915) 265.

[84] Proc. Roy. Soc. N. S. W. 51 (1918) 519; Trans. Roy. Soc. So. Austral. 47 (1923) 68.

[85] The Polyporaceae of New Zealand, *in* Trans. N. Zeal. Inst. 58 (1927) 217.

mined by Lloyd as *Fomes gibbosus* Nees. They are, in the senior author's opinion, more closely related to *Ganoderma mastoporum* than to any other species. It is, therefore, perhaps better to follow Bresadola's disposition of the matter and consider *nigrolaccatum* as a synonym of *applanatum.*

GANODERMA OROFLAVUM (LLOYD)

The first mention of this fungus was in Lloyd's determination of specimens sent by Henri Perrier de la Bathie, Madagascar,[86] in which he records, "Fomes australis Fr. As we are calling this form ad interim until the 'applanatus' group is revised. In the end this very distinct form with *yellow pore* mouths will have a distinct name probably. We have labelled it Fomes oroflavus." He includes it as *Fomes oroflavus* in his Synopsis of the Genus Fomes (1915) 265, with the statement that it is "a tropical form of Fomes applanatus with *yellow pore* mouths," etc., and cites specimens collected by Wilson in Australia and Forbes in Hawaii. In 1922 he[87] reports the fungus from the Philippines, likewise as a form of *applanatus.* In 1924, he reports it[88] from California and says that *Fomes brownii* (Murr.) is the same. Cleland and Cheel[89] in 1918 record the fungus from New South Wales and Nauru Island under the name *Fomes applanatus* var. *oroflavus.* Van der Bijl[90] records it from South Africa as *Fomes oroflavus* Lloyd and gives a description of his single collection. He adds the following remarks, "Except for the yellow pore mouths this plant is like *Fomes applanatus.* So far I have only seen the above recorded specimen and it is evidently not common. If it is merely a variation of *F. applanatus* it would appear strange that it should not be more common." Cunningham[91] reports it as *Fomes australis* (Fr.) Cke. var. *oroflavus* (Lloyd) from New Zealand.

There are three Philippine collections of this fungus at the Bureau of Science named by Lloyd. One of them (*8734*) is a portion of a young entirely resupinate plant of a single year's growth with a mature pore layer, collected at an altitude of 2,100 meters in the Mountain Province, Luzon. The pore surface is now between cinnamon-buff (R) and clay color (R).

[86] Letter 48 (1913) 8.
[87] Myc. Notes 67 (1922) 1164.
[88] Myc. Notes 72 (1924) 1289.
[89] Journ. of Proc. Roy. Soc. N. S. Wales 51 (1918) 518.
[90] So. Afr. Journ. Sci. 18 (1922) 278.
[91] Trans. N. Zeal. Inst. 58 (1927) 217.

The spores (Plate 33, fig. 7) are of the size and type of *applanatum,* to which Bresadola properly refers it. No. *36046* consists of portions of two broadly applanate pilei collected in the lowlands of Basilan Island. Both are distinctly tuberculose above, with thin context and relatively long hard pores, the mouths of which are now dark brown. The collection tends toward *tornatum* in one specimen (Plate 14, fig. 5) and toward *applanatum* var. *philippinense* in the other (Plate 14, fig. 6). It is one of those intermediate things upon which individual judgment must be used in classification. The writer prefers to consider it an extreme form of *applanatum* var. *philippinense* since the spores are exactly the same and the tuberculose crust is characteristic of that variety. No. *36097* is a fragment of an old sporophore, bleached within, which for like reasons is included in the same variety. In the Singapore herbarium there is another specimen (*8323*) determined by Lloyd and this is *Ganoderma williamsianum* Murr.

The character upon which Lloyd bases the species, namely, yellow pore mouths, is unsafe. It is a condition that is common in dried material of *tornatum* and is occasionally present in *applanatum* or its varieties. The fact that *oroflavus* is rarely reported from any particular region but has been recorded from such widely separated places as Japan, the Philippines, Australia, New Zealand, Madagascar, South Africa, Hawaii, and the western United States leads to the belief that it is nothing but a condition of growth, which is not worth segregating even as a form. Lloyd's concept being based on color of pores only does not take into consideration other more important variations that are indicated in the various published descriptions. For one thing it is certain that *Elfvingia brownii* Murr. of California is varietally distinct from any of the other forms or varieties that the writer has encountered and could not be considered synonymous with *oroflavus*.

GANODERMA SUBTORNATUM MURR.

Described from the Philippines by Murrill.[92] The type having been misplaced at the New York Botanical Garden could not be examined by the writer. The two other specimens (*Elmer 6943* and *7213*) cited by Murrill in the original description, however, have been loaned to us by the Kew herbarium. These appear referable to *G. mastoporum* and do not belong in the *applanatum* group.

[92] Bull. Torr. Bot. Club 34 (1907) 477.

Bresadola[93] named seven specimens from the Philippines for Elmer and the Bureau of Science. Of these, three are not represented in the herbarium (*Copeland 189, Elmer 10756,* and *Merrill 3691*). Likewise Graff's[94] specimen (*Bur. Sci. 16025*), reported as *Ganoderma tornatum* var. *subtornatum* (Murr.) Graff comb. nov., is missing. However, there are four specimens determined by Bresadola and one determination, as well as one confirmation, of Graff available. Four of these are referable to *Ganoderma applanatum* var. *philippinense* and are typical of this common variation. Lloyd calls two of them *australe* [*16634* (Plate 9, fig. 6) and *19239*], but they are entirely different from the senior author's concept of that variety. On the other hand, *Bureau of Science 19234,* determined *subtornatum* by Graff, is *gibbosum* for Lloyd but is good *tornatum.*

Lloyd[95] reported it from Madagascar in 1913 but later[96] stated the specimen was not typical. In his Synopsis of the Genus Fomes he maintains the species and records six collections from the Philippines sent by Merrill and one each from Java, Madagascar, and New Zealand. There are no specimens in Philippine herbaria, however, that are marked as his determinations. In the Singapore herbarium the name has been applied by Lloyd and others to various things that are mostly variants of the *mastoporum* group. There is also in that herbarium a specimen of *Elmer's Philippine Plants 6916,* which was distributed to Kew as *Elfvingia tornata.* Lloyd named it *subtornatum* but in reality it is *Ganoderma mangiferae* Lév., of which it has the characteristic long spores. When the Philippine collection of Polyporaceae passed through his hands about 1918 he supplied to the Bureau of Science an illustrated manuscript entitled History and Description of Philippine Polypores. This is dated November, 1918. In it he cites *Elmer 7213* and states that it "was named Polyporus subtornatus Murr. but is typically Polyporus mastoporus." This particular number of which Lloyd had a "frustule" is mentioned in Murrill's original description.

Cunningham[97] considers *Fomes subtornatus* as one of the three species of the *applanatum* group in New Zealand. His

[93] Hedwigia 51 (1911–12) 313; 53 (1912) 55.
[94] Bull. Torr. Bot. Club 48 (1921) 290.
[95] Letter 48 (1913) 8.
[96] Syn. Genus Fomes (1915) 269.
[97] Trans. N. Zeal. Inst. 58 (1927) 218.

illustration conforms well with the writer's conception of *Ganoderma applanatum* var. *philippinense*. His use of pore size as a distinguishing character will be discussed later.

Judging from the original description and the two specimens cited therein, all of which agree well with *G. mastoporum*, it would appear that *subtornatum* is synonymous with that species.

GANODERMA TESTACEUM (LÉV.)

Described by Léveillé from central Brazil.[98] The description calls for small stipitate specimens of a *testaceo-fuscus* color with an obtuse margin, the stipe being horizontal and appearing to be a prolongation of the pileus. Léveillé remarked that it appears to differ from *Polyporus gibbosus* Nees only in being much smaller and in the shortness of the stipe, which is not oblique but horizontal. The senior author has specimens from Brazil, sent by Father Rick as *Fomes applanatus*, that agree rather closely with the description. Comments will be offered later on these in comparison with the type which has kindly been loaned to us by the Paris Museum. Both Bresadola[99] and Patouillard[100] maintained the species. Lloyd mentions the fungus only twice,[101] as far as descriptive notes are concerned. Speaking of the type he says, "Brazil, Léveillé. Type at Paris a little deformed specimen of Fomes australis. Used in this pamphlet in the sense of Patouillard, not Léveillé."

Of the named material available for examination there are two specimens in the Bureau of Science (*18388 and 25107*) determined by Sydow.[102] In the Baker herbarium there is one specimen (*1662*) named by Patouillard. No. *18388* is typical *applanatum* var. *philippinense* (Plate 9, figs. 10 and 11); *25107* is a thin young applanate specimen with an acute margin that is intermediate between *applanatum* and *tornatum*, with spores of the former and general habit of the latter. It is not included in the present paper. *Baker 1662* has the spores and stipitate to substipitate habit of some forms of *tornatum*, to which we refer it (Plate 19, fig. 5). In this connection it may be worth noting that the senior author has collected on the same log numerous specimens of *tornatum* (*50028*) ranging from small forms

[98] Ann. Sci. Nat. III Bot. 5 (1846) 126.

[99] Ann. Myc. 10 (1912) 501; Hedwigia 56 (1915) 294.

[100] Bull. Soc. Myc. Fr. 5 (1889) 67; Leafl. Philip. Bot. 6, Art. 104 (1914) 2250; Ann. Crypt. Exot. 1 (1928) 18.

[101] Syn. Genus Fomes (1915) 270–271, 285.

[102] Ann. Myc. 15 (1917) 166.

with long irregular lateral stipes to typical sessile applanate forms (Plate 18).

GANODERMA TORNATUM (PERS.)

Described by Persoon from material collected on some island in the Pacific during the voyage of the Uranie.[103] The senior author, however, has not seen the original description. Fries,[104] two years after the publication of Persoon's species, described his *Polyporus australis,* likewise from an island in the Pacific. In 1874 he included the species in his Hymenomycetes Europaei [105] and extended its range to southern Europe, citing *P. tornatus* Pers. as a direct synonym. The type of *tornatum* exists at Paris according to Lloyd,[106] who states that Léveillé endorsed it "as being Fomes australis." Léveillé, however, although thus recognizing the priority never used the name *tornatus.*

Patouillard used the Friesian species throughout his works, with the broad interpretation that it also occurs [107] in southern Europe, Brazil, Cuba, Tierra del Fuego, New Caledonia, Cochin China, Canada, etc.

There are, however, four specimens in the Baker herbarium determined by him as *tornatum* and one packet marked "*australe* Fr. (*tornatum* Pers.)," indicating that he considered the two synonymous.

In one of his earlier papers Bresadola [108] remarked that he believed that *australe* Fr., which he says is very common in Europe, should be conserved and that *applanatum* Pers., very rare in Europe and better known in Africa, America, etc., should be considered a variety of it on account of the more echinulate spores. He does not seem to have followed this usage in any subsequent work, however. As late as 1911 he [109] used the name *australe* for Philippine material but in 1912 changed to *Ganoderma tornatum* (Pers.) Bres., citing as a synonym "*Ganoderma australe* Bres. hucusque pr. p. at aut. plur. nec Fries."

[103] Gaudichaud-Beaupré, Charles, Botanique du voyage autour du monde par ordre du roi sui les corvettes l'Uranie et la Physcienne pendant les années 1817–1820 par M. Louis de Freycinet. Paris (1826) 173.

[104] Elenchus Fungorum sistens Commentarium in Systema Mycologicum 1 (1828) 108.

[105] Hymenomycetes Europaei sive Epicriseos Systematis Mycologici, ed. 2 (1874) 556.

[106] Syn. Genus Fomes (1915) 286.

[107] Bull. Soc. Myc. Fr. 5 (1889) 71.

[108] Rev. Mycol. 12 (1890) 104.

[109] Hedw. 51 (1911–12) 313; 53 (1912) 55.

He thus maintains the two species but apparently reserves *tornatum* for the tropical and subtropical regions of the Pacific. *Fomes australis* Fr., he says, is only rarely met with in the Pacific islands adjoining the west coast of America. In another paper [110] published the same year he uses *tornatum* for Javan material with the remark that an examination of the original specimen indicates that *Polyporus australis* Fr. is different from *P. tornatus* Pers., and quite rare, while *P. australis* auctt., on the contrary, pertains to *P. tornatus* Pers., a species met with everywhere in the Tropics.

Lloyd preferred the old usage, but in his later years did not apply *australe* with any degree of consistency, since many Philippine specimens that he should logically have referred to it he placed in *applanatum*. In discussing the "section Ganodermus" in the Philippines he [111] places them under seven specific names, including both *tornatus* and *australis*. He does not make himself clear, however, as to the characters distinguishing the two.

Bourdot and Galzin [112] include *Ganoderma australe* (Fr.) Pat. as a subspecies occurring in France. They say it is very close to *G. applanatum*, but in general rather easy to distinguish. It certainly is not what has been called *australe* of the eastern Tropics.

Rea [113] records *G. australe* (Fr.) Pat. for England but his description calls for a fungus "encrusted on the surface with a sticky resinous coating, which dries up into tubercular ridges, and becomes laccate and shining." This seems to be a conception different from that of the French authors.

On the whole it appears that the only logical way to treat the subject is to consider *tornatum* the proper name to apply to Oriental tropical and subtropical specimens formerly placed in *australe* by most authors. Graff [114] has done this and Murrill has also done so in principle, although his interpretation of *tornatum* is very indefinite, many of his determinations being erroneous. He includes it in the North American Flora [115] and other publications as *Elfvingia tornata* (Pers.) Murr., stating that it is "abundant and widely distributed in tropical America;

[110] Ann. Myc. 10 (1910) 502.
[111] Myc. Notes 67 (1922) 1164–1165.
[112] Hyménomycètes de France (1928) 612.
[113] British Basidiomycetae (1922) 598.
[114] Bull. Torr. Bot. Club 48 (1921) 289.
[115] Volume 9 pt. 2 (1908) 115.

also in tropical Asia." It is also recorded in his Tropical Polypores (p. 91) as "extremely common throughout the tropics on decayed logs and stumps." It is mentioned in Southern Polypores (p. 61) that a doubtful specimen was received from Austin, Texas, and in Western Polypores (pp. 29–30) as doubtfully collected on *Quercus agrifolia* and *Umbellularia* near Berkeley, California. These are the hosts of *Elfvingia brownii* Murr., but the description does not seem to apply. He also reports it from Japan [116] with the inference that it is very common there; he apparently has confused it with a form of *applanatum* that is frequently collected in those islands.

The specimens reported as *tornatum* in the published records of Philippine fungi are thirty-four in number. Of these there are available in the Bureau of Science *137, 167, 193, 1223, 5087,* and *8932,* determined by Murrill;[117] *14376,* determined by Bresadola and Sydow [118] and confirmed by Graff; and *18341,* determined by Sydow. Besides these published numbers there are also five collections [*35833, 35870, 36007, 36121,* and *36130* (Plate 16, fig. 3)] determined by Lloyd, one by Bresadola (*9100*), one by Graff (*20389*), and *Fungi Exotici Exsiccati 308* of Sydow. Of these, *193* (*applanatum* for Lloyd), *14376* (Plates 17, fig. 24; Plate 35, fig. 1), and *18341* are typical *tornatum* of the Philippines; *8932* is a typical young specimen of variety *philippinense* such as Patouillard called *leucophaeum; 20389* is a large-spored form of *tornatum,* which we segregate as forma *macrospora;* Sydow *308* is a compressed ungulate variety of *applanatum* with very thin context and smooth spores, which will be segregated as soon as the type of *annulare* can be examined. The others are all referable to the *Ganoderma mastoporum* assemblage. It should be noted here that among the missing specimens of *tornatum* there are *16025,* which Graff [119] published as "Ganoderma tornatum var. subtornatum (Murr.) Graff comb, nov.;" and *13748,* determined by Bresadola, which according to Lloyd [120] is now at Kew and is the type of his *Fomes pseudo-australis.*

There are a number of other published species that belong in the *applanatum* group but upon which we can offer nothing

[116] Mycologia 15 (1923) 100.
[117] Bull. Torr. Bot. Club 35 (1908) 409.
[118] Philip. Journ. Sci. § C 9 (1914) 347.
[119] Bull. Torr. Bot. Club 48 (1921) 290.
[120] Myc. Notes 71 (1924) 1243.

constructive concerning the identity. A list of these with comments taken from the literature may be of some value in rounding out the paper.

POLYPORUS ADSPERSUS Shulz.

Placed by Patouillard [121] and Bourdot and Galzin as a synonym of *G. australe* (Fr.); by Bresadola as *australe* var. *europaea* Bres. (fide Bourd. and Galz.).

FOMES CHILENSIS Fr. [Nov. Symb. Myc. 63 (Sacc. Syll. 6: 176).]

Given by Bresadola [122] as a synonym of *australe* (Fr.), Lloyd [123] says: "The type at Upsala, all that is known to me, is a thin subresupinate Ganoderma, about the same as usually called australis."

POLYPORUS DRYADEUS (Rostk XXVII, t. 9).

Cooke [124] refers this to *applanatum*. Nicolas [125] gives the same reference for the fungus in Sturm Pilze, VII, Heft 27, p. 17, t. 9, 1841–53.

POLYPORUS DUBIUS Jungh. (Herb. Leiden).

Both Léveillé and Cooke [126] refer this to *australe* Fr.

BOLETUS FOMENTARIUS var. APPLANATUS PERS. [Syn. (1801) 536].

Bourdot and Galzin [127] give this as a synonym of *applanatum*. Lloyd,[128] speaking of the specimen in Persoon's herbarium at Leiden (Box 393), says there is a good specimen labelled by Persoon and it is *applanatus*.

POLYPORUS GALEGENSIS Mont. [Ann. Sci. Nat. II 16 (1841) 274–275].

Bresadola [129] transfers this to *Ganoderma* and maintains it as a species. In discussing the type collection of *nigro-laccatus* Cke. he refers one of the two specimens to *galegense*.[130] Lloyd [131] lists it as a valid species with the comment, "very similar to Fomes applanatus as to pores, context and spores, but has a

[121] Pat., *in* Bull. Soc. Myc. Fr. 5 (1889) 71; Bourd. & Galz., *in* Hym. France, (1928) 612.

[122] Ann. Myc. 14 (1916) 223.

[123] Syn. Genus Fomes (1915) 279.

[124] Grevillea 15 (1886) 54.

[125] Bull. Soc. Myc. Fr. 42 (1925) 190.

[126] Léveillé, *in* Ann. Sci. Nat. III Bot. 2 (1844) 189; Cooke, *in* Grevillea 15 (1886) 54.

[127] Hym. France (1928) 611.

[128] Myc. Notes 35 (1910) 469.

[129] Ann. Myc. 14 (1916) 236.

[130] Hedwigia 53 (1912) 54.

[131] Syn. Genus Fomes (1915) 265.

hard, thick, smooth, black (cracked) crust. The specimen on which the species is based is in a cupboard at Paris. We have noted other specimens of Fomes applanatus, determined as being Fomes galegensis, but none with the same crust feature of the type at Paris. We hardly think it possible to maintain it even as a form."

FOMES GELSICOLA Berl. [Malpighia (1889) 371; Sacc. Syll. 9: 180].

Bresadola [132] refers this to *australis* Fr. Lloyd[133] remarks, "No specimen known to me, but from figures, description, and spores, it is based on a half-ungulate specimen of Fomes applanatus."

POLYPORUS LACCATUS Kalchbr. [Österr. Bot. Zeitschr. 35 (1885) 81–82].

This is a European species recognized as valid by modern students [134] of the group, said to be the same as *G. pfeifferi* Bres. and *Fomes advena* Quél. Rea [135] gives it as a variety of *applanatum*. Lloyd's illustration resembles the form of *applanatum* var. *philippinense* which Patouillard called *leucophaeum* in Philippine collections.

POLYPORUS LINGUA Lév. (apud Zollinger No. 360, non. Nees).

Patouillard [136] places this in *G. testaceum* (Lév.), while Bresadola [137] refers another of Zollinger's specimens (*Pl. Jav. 350y*) to his new variety *pulchella* of *Ganoderma gibbosum* (Bl. and Nees) Pat.

POLYPORUS LINHARTII Kalchbr.

Patouillard refers [138] this species to *G. australe* (Fr.).

GANODERMA LIONETTII Rolland [Bull. Soc. Myc. Fr. 17 (1901) 180–181, pl. 8].

Murrill reports this in the North American Flora 9, part 2, page 115, from Nicaragua and Panama. A section of a small pileus in the senior author's herbarium from the former place determined by Murrill does not show the radiate wrinkling of the original illustration. It must be considered a doubtful determination. Lloyd [139] states, "Pileus covered with agglutinate wrin-

[132] Lloyd, Myc. Notes 3 (1899) 23.
[133] Syn. Gen. Fomes (1915) 280.
[134] Lloyd, Syn. Gen. Fomes (1915) 266, fig. 603; Bourd. and Galz., Hym. France (1928) 612.
[135] Brit. Basidiom. (1922) 597.
[136] Leafl. Philip. Bot. 6 (1914) 2250.
[137] Ann. Myc. 10 (1912) 501.
[138] Bull. Soc. Myc. Fr. 5 (1889) 71.
[139] Syn. Apus Polyporus (1915) 371.

kles. No specimens seen, but species evidently based on the surface characters as shown on Bull. Soc. Myc. 1901, plate 8. It was from Mexico." The last statement is an error; it was originally described from the Isthmus of Panama.

BOLETUS LIPSIENSIS Batsch. (Elench. Fung. Contin. Prima, 183–186, pl. 25, fig. 130, *a*, *b*, 1786).

Atkinson [140] uses this as the earliest specific name for *applanatum*.

FOMES LONGOPORUS Lloyd [Myc. Notes 62 (1920) 940].

This species was named from Portuguese West Africa, but not adequately described or figured. The large pores are the only diagnostic character given.

POLYPORUS MERISMOIDES Corda [*in* Sturm Pilze III (1837) 139, t. 63].

Placed by Cooke [141] and Nicolas [142] as a synonym of *applanatum*. Saccardo (Syll. 6: 177) includes it as a "forma monstrosa" of *applanatum*.

POLYPORUS NIGRICANS Jungh.

Lloyd [143] says of this, "=Fomes australis teste Fries."

POLYPORUS OERSTEDII Fr. [Nov. Symb. (1851) 63].

Murrill [144] places this as a synonym of *tornatum*. Bresadola, Lloyd, and Saccardo consider it a valid species.[145]

POLYPORUS PICEUS Ces. [Mycetum in itinere Borneensi lectorum, p. 5, *in* Atti. Reale Accad. Sci. Fis. e Math. Napoli 8: (1879)].

Lloyd [146] says of this, "No type known by me, but probably the same as Fomes pseudo-australis or Fomes subtornatus." The description suggests *mastoporum*.

FOMES POLYZONUS Lloyd [Syn. Gen. Fomes (1915) 269–270].

Originally collected by C. B. Ussher in Java.

[140] Ann. Myc. 6 (1908) 189.
[141] Grevillea 15 (1886) 57.
[142] Bull. Soc. Myc. Fr. 42 (1925) 190.
[143] Syn. Genus Fomes (1915) 283.
[144] N. A. Flora, Part 2, 9 (1908) 115.
[145] Bres., *in* Ann. Myc. 14 (1916) 239; Lloyd, *in* Syn. Apus Polyp. (1915) 370, fig. 705; Sacc. *in* Syll. Fung. 6: 178.
[146] Syn. Gen. Fomes (1915) 284.

BOLETUS RUBIGINOSUS Schrad. [Spic. Fl. Germ. (1794) 168].

Fries and Saccardo place this as a synonym of *Polyporus resinosus*.[147] Quélet [148] reported it for France, but Bourdot and Galzin [149] consider his fungus the same as *applanatum*.

Lloyd [150] remarks, "Europe, Schrader. This old vague record has been variously interpreted. Fries (late date) as a synonym for Polyporus fuscus of this pamphlet. Fries (at an early date) as Polyporus fissilis of this pamphlet. Fries specimen at Kew is Polyporus cuticularis. Bresadola Fungus Kmet. as Fomes applanatus, which is probably correct. The 'farina rubiginosa' of the pileus is no doubt the spore deposit that often mysteriously covers the top of the pileus of Fomes applanatus."

POLYPORUS SCANSILIS Berk. [Journ. Linn. Soc. Bot. 16 (1877) 53].

Described from a specimen (279) collected by the Challenger Expedition in Juan Fernandez. Lloyd [151] says, "Based on a diseased condition of Fomes australis when the context has turned white. These conditions are not rare even in European and American forms of *Fomes applanatus*. I do not know what causes it, but judge it is a disease of some kind." Bresadola [152] calls it *Ganoderma australe* (Fr.) forma *albinea*.

FOMES STEVENII Lév. [*in* Demidoff, Voyage dans la Russie méridionale et la Crimée, par la Hongrie, la Valachie et la Moldavie 2 (1842) 91, pl. 2].

Bresadola [153] states, "unknown, probably vegetus." Lloyd [154] says, "Specimen is not preserved in any museum I have visited. I have been told that it is in Italy. From the figure and description I judge it is Fomes leucophaeus."

FOMES VEGETUS Fr. [Epicrisis (1836–38) 464].

Although carried in Saccardo (Syll. 6: 179) as a valid species it is now quite universally considered a form of *applanatum*

[147] Fries, Hym. Eur., ed. 2 (1874) 554; Sacc. Syll. 6: 137.
[148] Assoc. Franç pour l'avanc. Sci., 20th sess. 2 (1891) 469.
[149] Hym. France (1928) 611.
[150] Syn. Apus Polyporus (1915) 385; *also see* Syn. Genus Fomes (1915) 284–285.
[151] Syn. Genus Fomes (1915) 285.
[152] Ann. Myc. 14 (1916) 227.
[153] *In* Lloyd, Myc. Notes 3 (1899) 22.
[154] Syn. Gen. Fomes (1915) 285.

or *australe* with cushions of sterile tissue between the layers of pores.[155]

GANODERMA APPLANATUM (Pers.) Pat.

TEMPERATE-ZONE FORMS

UNITED STATES AND CANADA

Only seventeen specimens from the United States were available for examination (Plate 1, figs. 1 to 13). The senior author has collected it there frequently, however, in various parts of the country, and it is believed that the specimens studied are quite representative. On large logs or trunks it may reach a width of two feet or more. It is usually applanate, rarely ungulate, and usually grows singly, although many sporophores may occur scattered in close proximity over the logs. Occasionally it becomes loosely imbricate. While frequently strictly sessile and semicircular in outline there are also many forms that are contracted to a lateral stipelike base. Many of the sessile plants have a broad basal attachment, which in turn produces a strongly concave lower surface. Specimens growing in the dark or under much-reduced illumination frequently assume long digitate forms (Plate 1, fig. 12), while others are sufficiently regular (Plate 1, fig. 11) for easy determination.

The upper surface varies from almost plane to strongly convex, and is sulcate in all the specimens studied, becoming somewhat tuberculose or radially furrowed at times. The color is frequently dirty whitish, pale smoke gray to somewhat silvery, or near light buff (R), these light-colored specimens frequently having narrow concentric light brown zones; older or poisoned specimens are usually darker. The following additional colors of Ridgway have been noted: Clay color, Sayal brown, grayish olive or paler, near snuff brown, Verona brown, between army brown and Natal brown, and Saccardo's umber. It will be noted that five of these seven colors are on Plate 29 of Ridgway's Color Standards. Color zonation is present in nearly all to some degree.

The margin is subacute to blunt, and is often pale. The context varies from corky to woody, usually with distinct concentric zones, and is sometimes much thickened at the attachment.

[155] *See* Bourdot and Galzin., Hym. France (1928) 612; Hennings, *in* Engl. Bot. Jahrb. 14 (1891) 342; Lloyd, Letter 24 (1908) 2; Letter 44 (1913) 4; Syn. Gen. Fomes (1915) 286; Patouillard, *in* Bull. Soc. Myc. Fr. 5 (1889) 71; van der Bijl, *in* So. Afr. Journ. Sci. 18 (1922) 279.

It ranges for mature specimens between 1.5 and 6 centimeters thick, the fibers often radiating, particularly at the base. Narrow, harder radial streaks or interrupted lines are invariably present. These are most conspicuous at or near the attachment, where they usually radiate abundantly and thereby harden the tissue. They usually continue toward the margin in varying numbers and frequently almost attain it. They are black in most specimens but may occasionally be dark brown. The typical color of the context is near russet (R) but cinnamon brown (R), Sayal brown (R), Verona brown, (R), Mars brown (R), and snuff brown (R) were noted, two or more of these often being represented in the same specimen, sometimes as concentric bands, sometimes as color variations between the upper and lower areas. Where variations exist the area next to the pores is the darker. It will be noted that the colors mentioned above are closely related, largely a matter of minor shades. The greatest difference was in a specimen collected by J. R. Weir from *Abies grandis*, a very unusual host, in Idaho. The upper portion of the context was pinkish buff (R), the lower portion snuff brown (R). This was a young specimen, Saccardo's umber on the upper surface, and was quite aberrant, although unquestionably referable here.

A distinct crust (Plate 25, fig. 1) is present in all instances. This is not over 0.25 millimeter thick and is for the most part black in section, occasionally dark brown. In many cases it can easily be indented by the finger nail.

In fresh growing specimens the lower surface is white to whitish but on drying it becomes pallid to sordid, and on bruising becomes brown by exposure of the brown dissepiments of the tubes. This character makes it suitable for amateur sketching (Plate 1, fig. 7). The pore surface in herbarium specimens, therefore, shows a wide range of color, depending on the age and the amount of care used in handling the fresh material. Poisoning with corrosive sublimate dissolved in alcohol also darkens the surface, even of dried material. The color of the lower surface in the material at hand, most of which is unpoisoned, varies from near light ochraceous buff, sometimes tinged with olivaceous, to rather dark brown. The Ridgway colors noted are deep olive buff, near wood brown, buffy brown, near Saccardo's umber, Natal brown, and dusky brown; army brown to Verona brown where distinctly bruised.

The sporophores have one to four layers of pores (Plate 25, fig. 1), varying in maximum length from about 1 to 1.5 centimeters for well-developed specimens. Their general color in longisection ranges within the following limits (Ridgway): Light brownish drab, brownish drab, near cinnamon drab, near wood brown, near snuff brown, and near Verona brown. The presence of white mycelium within many of them lightens the shade somewhat in section, the dissepiments, as a rule, being the color of the lower layer of context from which they arise. The orifices (Plate 22, figs. 1, 2, and 5) are circular to angular, the dissepiments thin to thick, but more usually thin to medium, with the edges often somewhat eroded. They vary in size up to 100 per cent (ratio 1 : 2). In number per millimeter the averages of five to six measurements per specimen range from 4.5 to 6.7, the grand average for ninety-two measurements on sixteen specimens being 5.3.

Six representative specimens were examined (ten measurements per specimen) for ratio of pore-wall thickness to diameter of pore. The walls varied from 42 to 417 μ and the pores from 139 to 486 μ the average ratios [156] for the five specimens being 1: 0.73, 1: 1.60, 1: 2.10, 1: 2.54, 1: 2.75, and 1: 2.77, respectively.

A form of *Ganoderma applanatum* with a large part of the context and the older pore layers bleached to light buff (R) or pinkish buff (R) occurs in the western United States (Plate 1, fig. 1). The writer has frequently found it on *Tsuga heterophylla* and occasionally on oak in the Pacific Coast region. In as much as the form is frequently associated with typical specimens it cannot be considered more than a minor variation, although it is of striking appearance in section. It varies from applanate to compressed-ungulate; one small specimen is ungulate and was attached at the vertex. The upper surface is fawn color (R) to Verona brown (R), often blackish where rubbed. The context is comparatively thin, with radiating fibers, corky, whitish to light buff (R) and may be heavily streaked with Sayal brown (R) to Saccardo's umber (R), obscurely zoned, and with a few dark brown harder streaks. The crust (Plate 29, fig. 1) is thin, up to ⅔ millimeter, and frequently cracked. The pores are indistinctly layered, occupying from three-fourths to seven-eighths of the total thickness. All

[156] Ten measurements each of the walls and the diameter of the pores were made. These were added and the total of the wall thickness was divided into the total of the diameter to give the average ratio.

except the last layer (Plate 30, fig. 1; Plate 31, fig. 1), and perhaps a portion of the next to the last, are bleached to light buff (R) or pinkish buff (R) with occasional scattered vertical streaks of the same color as the unchanged pores, which are near to Verona brown (R) or snuff brown (R) in longitudinal section. The under surface is nearly concolorous with the pore section.

This same bleaching is also found in specimens of *applanatum* or its variants from the Philippines (Plate 5, figs. 13 and 14; Plate 28), and elsewhere, and the tendency for the context to be somewhat lighter just beneath the crust, even to becoming light buff, can frequently be noted. Lloyd, and Cleland and Cheel speak of this bleaching as being caused by a parasitic growth. I am of the opinion that it is an autodigestive process, since the hyphæ are much smaller in diameter and with thin walls (Plate 31, fig. 2) as if they had been subjected to gradual uniform fermentation.

Spores (Plate 32, figs. 1 to 3) in the United States material are brown in mass. At 500 to 600 magnification, after treatment with 7 per cent potassium hydroxide, the young ones vary from olive buff (R) to deep olive buff (R) while the older, more mature, ones are somewhat darker, ranging from deep olive buff to dark olive buff (R). The characteristic striæ in the hyaline epispore vary from fine to moderately coarse (oil immersion) and are distinct; usually they are rather fine. Those derived from a crushed mount of the pores average for one hundred fifty measurements (ten each from fifteen different collections) 5.41 by 8.15 μ; while forty measurements of spores from the upper surface of four collections gave an average of 6.35 by 9.15 μ.

SPECIMENS EXAMINED

CANADA, Quebec, Lake Kenogami near St. Cyriac, on *Betula* sp., *C. J. Humphrey 10406* (H).[157]

UNITED STATES, Florida, Miami, on living *Cocolobus* sp., *C. J. Humphrey 6981* (H.); Idaho, Clearwater, on *Abies grandis*,

[157] Abbreviations are given in parenthesis, following the number, to indicate the herbaria in which the specimens cited are deposited. Thus, (B) refers to the Baker herbarium, at Los Baños, Philippine Islands; (Bg) to the Buitenzorg herbarium; (B. S.) to the Bureau of Science, Manila; (H) to the Humphrey herbarium; and (S) to the Singapore herbarium. Since the largest part of the specimens are from the Bureau of Science herbarium this designation has been omitted wherever possible, although it was necessary to use it in referring to exsiccatæ specimens, or Bureau of Science specimens deposited in duplicate in the Baker herbarium.

C. H. Shattuck (ex herb. J. R. Weir) (B.); Illinois, Cypress, on *Fraxinus nigra, C. J. Humphrey 1369* (H.); Iowa, Woodbine, on *Pyrus malus, C. J. Humphrey and C. W. Edgerton 2344* (H); Maine, Bowdoinham, *C. G. Penney, Bu. of Plant Industry pathological and mycological collections 962* (B. S.); Minnesota, Princeton, on living *Quercus alba, C. J. Humphrey 934* (H.); New York, Syracuse, Catskill Mountains, on *Acer saccharum, L. H. Pennington,* New York State College of Agriculture *13* (B.); Oregon, Eugene, on *Quercus lobata, C. J. Humphrey 6083* (H); Pennsylvania, Sayre, *W. C. Barbour, Kryptogamae exsiccatae* [*Vienna*] *1143* (B. S.); Washington, Hoquiam, on *Tsuga heterophylla, C. J. Humphrey 2348* (H), *6365* (H); Wisconsin, Madison, *M. C. Jensen* "B" (B. S.), on living *Pyrus malus, C. J. Humphrey 881* (H), on living *Prunus serotina, C. J. Humphrey 882* (H), on *Salix* sp., *M. C. Jensen* "C" (B. S.), Menasha, on *Acer* sp., *M. C. Jensen* "A" (B. S.).

EUROPE

Four specimens only were available from Europe; namely, two from England, one from Austria, and one from Russia. All were represented by slices. One of the English specimens was ungulate, with at least seven layers of pores which were nearly continuous (Plate 1, fig. 14). Context hard corky, russet, with small interrupted bleached streaks; pores between Verona brown (R) and snuff brown (R); the other specimen was small, applanate, of harder consistence throughout, and with somewhat darker context. This latter can frequently be closely matched with Japanese material, and occasionally with Brazilian. Both have circular to subangular pores, with medium to thick entire dissepiments (Plate 22, figs. 3 and 4; Plate 25, fig. 7). In one they average 4.2 to a millimeter, in the other 4.9.

The Russian and Austrian specimens were of light weight, applanate, and quite alike in color and consistency. Context corky and very light colored for the species, near clay color (R) above and warm sepia (R) next to the pores in the Austrian specimen; predominantly the latter color throughout the Russian. Upper surface tinged with olivaceous, with a thin soft crust. Pores near wood brown (R) in section; the mouths circular to angular, the dissepiments thin to medium, entire to somewhat eroded, averaging 4.7 to the millimeter in the Austrian specimen. Both plants were of the *"vegetus"* type with dis-

tinct layers of sterile tissue between the pore layers. They offer a distinct variation from the English material at hand.

The English and Austrian specimens were examined for ratio of pore wall thickness to diameter of opening. The walls in the former varied from 56 to 306 μ and the pores from 167 to 459 μ, with average ratios of 1 : 0.98, and 1 : 2.73, respectively. The Austrian specimen ranged from 28 to 167 μ for the walls and 208 to 445 μ for the pores, with an average ratio of 1 : 3.79.

The spores of the European material offer little variation from the American. Those from the English specimens (Plate 32, figs. 4 and 5) averaged 6.1 by 9.6 μ; from the Austrian 5.2 by 7.8 μ; and from the Rusian 6.2 by 9.2 μ. The above measurements were all made on spores crushed from the pore tissue.

SPECIMENS EXAMINED

AUSTRIA, Sonntagberg Mountains, near Rosenau, *P. P. Strasser, Kryptogamae exsiccatae* [*Vienna*] *940* (B. S.).

ENGLAND, Epping Forest (*ex Herb. Hort. Bot. Reg. Kew.*) (B. S.); Kew, *A. D. Cotton* (*ex Herb. Hort. Bot. Reg. Kew.*) (B. S.).

RUSSIA, Province Černigov, district Ostjor, prope Černyn, on *Populus tremula, G. Newodowski* (B.).

SOUTH AMERICA: URUGUAY

One typical specimen from Montevideo was examined (Plate 2, fig. 1). This was thick, two-layered, with a bay (R), firm corky context 2 centimeters thick and a cushion of sterile hyphæ between the layers. Upper surface weathered, approaching grayish olive (R), rimose, sulcate. First layer of pores 2 centimeters long, typical in color, with rather thick-walled dissepiments. Spores typical in color, with coarse distinct striæ, rather large, but falling well within the range for the species, averaging 6.5 by 10.7 μ for ten measurements from a crushed mount.

SPECIMEN EXAMINED

Montevideo, *Carnevale, Mus. Botan. Montevidens, 782.*

JAPAN

Nine specimens (Plate 1, figs. 15 and 16; Plate 2, figs. 2, 3, 4, 7, to 11) from southern and northern Japan were examined. These were all comparatively small, up to 11 centimeters long, about 12 centimeters wide, and 3 centimeters thick, none being of the large broadly applanate form so common in the United States. Most of them were strictly sessile, but one was contracted to a stipelike base. Upper surface usually convex,

sulcate, often rather irregular, varying in color from dull silvery gray through avellaneous (R) and fawn color (R) to brown; black in occasional old specimens. One specimen was near smoke gray (R) concentrically banded with benzo brown (R) (Plate 2, figs. 7 and 8). Another very young specimen was Natal brown (R) at the margin, then wood brown (R), and finally near cartridge buff (R) behind.

The lower surface varied from near pinkish buff (R) through pale brownish with olivaceous cast to wood brown (R), and finally to buffy brown (R), or occasionally olive-brown (R), becoming benzo brown (R) to dark vinaceous drab (R) on bruising.

Context corky to woody, usually varying from cinnamon brown (R) and russet (R) to chocolate (R), the colors often being mixed in the same sporophore. One specimen had a narrow Verona brown (R) layer next the pores, shading out to light buff beneath the crust. Obscure to distinct concentric zones were present in all, the fibers radiating from the base and becoming more parallel toward the margin. Hard, shining black, interrupted streaks (Plate 25, fig. 5) were numerous at the base of the sporophores, and frequently extended in lesser number nearly to the margin. Where abundant the tissue was quite hard.

A hard black crust varying from 0.25 to 1 millimeter in thickness was always present, the thickness determining the ease with which the crust could be indented. It was frequently cracked in dried specimens and usually extended entirely around the blunt margin; sometimes, however, in specimens with an actively growing margin it was absent over that portion.

In longisection the pores varied from near wood brown (R) to near chestnut brown (R) or Mars brown (R). Most of the specimens showed only one pore layer and since this was frequently not fully developed the pores were only 5 to 7 millimeters long. In those plants collected previous to the month of May the pores apparently represented the previous year's growth and varied from 13 to 20 millimeters in length. In shape (Plate 22, figs. 7 and 8) they varied from circular to angular, more commonly subangular. In some specimens they were almost uniform in size; in others the ratio ran as high as 1 : 2, the average for nine specimens examined being 1 : 1.4. The average number per millimeter was 4.8, based on sixty measurements on nine specimens, the averages for the different specimens ranging between 4.0 and 5.7. The dissepiments va-

ried from thin to thick, the more usual condition for mature specimens being thin to medium, the thinner ones being frequently eroded.

Three specimens were examined for the ratio of pore-wall thickness to diameter of opening. The walls varied from 70 to 417 μ and the pores from 111 to 417 μ, the average ratios being 1 : 1.08, 1 : 1.44, and 1 : 3.36, respectively.

The spores (Plate 32, figs. 6, 7 and 8) had the same variation in color as the American material, but the striæ tended to be coarser. All gradations from fine to coarse were present, however. Those derived from the crushed pores averaged for eighty measurements on eight collections 5.45 by 8.35 μ. Ten measurements of spores from the upper surface of one specimen averaged 6.3 x 9.5 μ. These measurements are in close agreement with those from American specimens and are in sufficiently close accord with those from European material.

Among the Japanese specimens there were two (*11537, 12586*) which had the same type of smooth nonstriate spores as later described by the senior author for *Ganoderma applanatum* var. *laevisporum*. While one of these (*11537*) was sufficiently distinct from *applanatum* to constitute a good variety (Plate 1, figs. 15 and 16; Plate 32, fig. 8) the other was indistinguishable, in all characters except spores, from another specimen (*11618*) which had typical striate *applanatum* spores. Therefore it seems best to leave all in the base species until enough material is available to make the proper varietal segregation. At present the senior author would consider the smooth-spored forms as transitional between *applanatum* and its more southern high altitude variety *laevisporum*.

SPECIMENS EXAMINED

Tokyo, Meguro, Forest Experiment Station, on *Fraxinus* sp., *K. Kitajima* (*1*), on *Quercus serrata, R. Fukazu, comm. K. Kitajima* (*21*) *12502* (H); Kyoto, *T. Hemmi et al.* (*25*); Yamato Province, Kamikitayama-Mura, Yoshino-gun, *H. Migo* (*20*) *12587* (H), Kawakami-Mura, Yoshino-gun, *H. Migo* (*19*) *12586* (H); Hyuga Province, Aoshima, *H. Migo* (*24*) *12589* (H); Osumi Province, Koyama, *H. Migo* (*25*) *12583* (*H*); Nikko, Lake Chuzenji, *C. J. Humphrey, K. Kitajima and I. Miura, 11537* (H); Tomakomai, *C. J. Humphrey and I. Miura, 11617* (H), *11618* (H); on *Acer palmatum, C. J. Humphrey and I. Miura, 11621* (H).

CHINA

Three collections were available for study, one of which was rather abortive. The other two were applanate, sulcate to rugose-sulcate, approaching smoke gray to grayish olive or wood brown above (Plate 2, figs. 5 and 6). Context corky to very firm, up to 2 centimeters thick, concentrically zoned, near to russet (R), but varying either somewhat darker or lighter. Under surface strongly tinged with olive buff. Pores (Plate 22, fig. 9) with a maximum length of 11 millimeters, angular to subangular, averaging 4.7 to a millimeter; ratio of variation 1 : 2. Dissepiments thin to medium, entire to somewhat eroded. The plants approach sufficiently close to American material and in turn resemble certain of the Philippine collections.

Spores of the same color as in American and European specimens, the striæ being rather coarse, the average of thirty measurements from crushed mounts of three collections being 5.5 by 8.3 μ.

SPECIMENS EXAMINED

Kwangsi, Tang Uen, *O. A. Reinking, 4593* (B); Kwangtung, Paak Shan, on *Nephelium lichee, O. A. Reinking, 4684* (B); Hongkong, *C. J. Humphrey, 11623* (H).

FORMOSA

Five good specimens from Formosa were examined (Plate 2, figs. 12 and 13). These varied from a small subungulate form to applanate, and from sessile or contracted at the base to short laterally stipitate, convex, sulcate, and occasionally somewhat tuberculose above; largest specimen 15 centimeters long, 5 centimeters thick at base. Upper surface varying from light buff tinged with avellaneous (R) (in a very young specimen) through wood brown (R) to drab (R), and finally hair brown (R) in old specimens.

Context corky to woody, from 1 centimeter to 3 centimeters thick, russet (R) to chocolate (R), usually concentrically zoned with bands of somewhat lighter color; the usual hard black streaks and distinct black crust present in all specimens.

Lower surface of the youngest specimen (1.75 inches long) cartridge buff (R) at the sterile margin and light buff (R) over the remaining area. Older specimens were drab gray (R) and light drab (R) to mummy brown (R), with the exception of one specimen that was stained with olive buff over part of the surface.

All specimens had a single pore layer which varied from 4 millimeters to 2 centimeters thick, the dissepiments being concolorous with the lower layers of the context, the tubes often white within; general color varying from a pale benzo brown to warm sepia (R).

The pores (Plate 22, fig. 10) varied in shape from circular to angular, more commonly subangular to angular, with medium to thin dissepiments, which were entire or somewhat eroded. The size varied about 50 per cent. The number per millimeter varied from 4.4 to 5.2, the average for twenty-four measurements on four specimens being 4.8.

Three representative specimens were examined for ratio of pore-wall thickness to diameter of opening. In forty measurements the walls varied from 56 to 250 μ and the openings from 167 to 486 μ, the average ratios for the three being 1: 1.86, 1: 2.26, and 1 : 2.42, respectively.

The spores (Plate 32, fig. 9) were of typical color, with rather coarse striæ. Those from crushed mounts averaged for thirty measurements on three specimens 6.46 by 9.56 μ, while twenty from the upper surface of two other specimens averaged 6.30 by 9.35 μ. They are thus practically the same size as those from American, European, and Japanese specimens. Similarities in all other respects are likewise quite close.

SPECIMENS EXAMINED

Mahebo, *K. Sawada* (*6*) (H); Taihoku, *K. Sawada* (*66*, *78*) (H), on *Nephelium longana, K. Sawada* (*50*) (H); Toyohara, on living *Alnus formosana, K. Sawada* (*68*) (H).

AUSTRALIA

Fourteen specimens were examined, all from the temperate regions (Plate 3, figs. 1 to 11; Plate 25, fig. 2). They varied widely in shape and thickness of context but had the general appearance of the species. Several were subungulate, others comparatively thin applanate. Upper surface sulcate, sometimes very uneven, rather rimose in age. One young specimen was near Sayal brown (R) above, but they were for the most part pale brown to Verona brown (R) or darker, in some cases tending toward blackish. Two of them were grayish olive (R) to dark grayish olive (R), at least over part of the surface.

The context was corky, from 4 millimeters to 3.5 centimeters thick, usually around auburn (R) to bay (R), occasionally russet; with the upper layer cinnamon brown (R) in one specimen. The hard black streaks in the context, usually so conspicuous

in *applanatum* collections were lacking or inconspicuous in many of the Australian. They were replaced to a certain degree in some of the specimens by softer fawn-colored, more or less interrupted, streaks (Plate 3, figs. 5 and 6), such as one frequently finds in variety *philippinense*.

The pore surface was usually pallid to medium brown. The pores (Plate 22, fig. 6; Plate 25, fig. 2) varied from circular to angular, most of them being subangular to angular, differing in size in a single specimen about 50 per cent. They ranged between 3.5 and 5.5 to a millimeter, with averages based on six measurements on each of six specimens from 4.1 to 5.0, the average of the whole series being 4.8.

Six specimens were examined for ratio of thickness of dissepiments to size of pore orifice. The walls varied from 56 to 278 μ and the pores from 83 to 278 μ, the respective average ratios for the six being 1 : 0.70, 1 : 1.07, 1 : 1.33, 1 : 1.46, 1 : 1.47, and 1 : 2.01. It is thus seen that the pores average somewhat larger than in the forms from the United States. Dissepiments thin to thick, more usually medium to thick, the thin ones being somewhat eroded at times.

The spores (Plate 32, figs. 10 to 12; Plate 33, figs. 1 and 2) varied from olive buff to dark olive buff, with rather coarse distinct striæ. They averaged rather large for the species, those derived from crushed mounts being 6.69 by 10.76 μ, based on eighty measurements, ten spores from each of eight specimens. Those from the upper surface were slightly larger and averaged 6.98 by 11.07 μ (one hundred four measurements from ten specimens). In respect to size they are nearly as large as the spores of variety *brownii* Murr. from the Pacific coast of the United States. In other respects some of the Australian plants (Plate 3, figs. 1 and 2) also approach the American variety, but there appear to be sufficient minor differences to warrant retaining them in the base species rather than to increase the variability of the variety.

Certain of the specimens were thin and applanate, with the thin context of variety *tornatum*, but otherwise they are better referable to *applanatum*, particularly in the size and character of the spores. Only one specimen had typical *tornatum* spores; on other characters, however, it would normally be placed in thin *applanatum*. There is so much intergrading in the *applanatum* assemblage that some fairly constant character, such as the spores, must be selected for varietal segregation and hence this specimen has been placed under the variety indicated.

SPECIMENS EXAMINED

Flinders Island, Bass Straits, *J. B. Cleland* (*9*); New South Wales, *J. B. Cleland* (*10, 27*), Lisarow, *J. B. Cleland* (*8*), Mount Wilson, *J. B. Cleland* (*7*), National Park, *J. B. Cleland* (*3*), Sydney, Mosman, on living *Angophora lanceolata, J. B. Cleland* (*2*), Wingham, *J. B. Cleland,* (*5*); Queensland, Bunya Mountains, *J. B. Cleland* (*11*); South Australia, Adelaide, Burnside, on old pepper tree, *Schinus mollis, J. B. Cleland* (*1*), Encounter Bay, *J. B. Cleland* (*13*); Tasmania, National Park, *J. B. Cleland* (*14*); Victoria, on decaying log, Upper Fern-tree Gully, *E. Cheel* (*Nat. Herb. N. S. Wales, 5990*) (B); West Australia, Perth, Zoölogical Gardens, *W. N. Cheesman* (*ex Herb. Hort. Bot. Reg. Kew.*) (B).

NEW ZEALAND

A portion of a small subungulate specimen from Dr. J. B. Cleland was examined. This was in close agreement with certain of the Australian specimens. Upper surface dark, tinged with hair brown, sulcate, rimose, with a black crust 3 millimeters thick. Context somewhat darker than bay, corky. Lower surface light brown, discolored, with circular to subangular pores 4.2 to the millimeter. Dissepiments thick, entire. Spores of typical color, with moderately coarse distinct striæ, 6.7 by 10.4 μ (crushed mount), 6.9 by 10.7 μ (from upper surface).

SPECIMEN EXAMINED

Wellington, *J. B. Cleland* (*4*).

TROPICAL FORMS

BRAZIL

Eight Brazilian specimens collected by Father Rick were examined (Plate 4, figs. 1 to 10), the description being drawn from the six referable to *applanatum*. These varied from moderate-sized ungulate or applanate forms to small substipitate ones, and in consistency from corky to hard and woody. Upper surface broadly to lightly sulcate (in steps in the ungulate specimen), usually convex and occasionally somewhat tuberculose; color varying from avellaneous (R) and wood brown (R) to cinnamon brown (R); one aberrant specimen of a general clay color (R) obscurely banded with Verona brown (R).

The context color varied within the usual limits, around russet (R), auburn (R), chestnut (R), and bay (R). Where comparatively thick it showed obscure to distinct concentric

zones. The forms with thin context approached variety *tornatum* of the eastern Tropics in that respect but appeared more closely allied to *applanatum* in other characters and could not be specifically separated from other specimens with thick context from the same region. They were also very much like several of the specimens from Japan. Hard black streaks, abundant to occasional, were present in all specimens; also a hard black crust from 0.2 to 1 millimeter in thickness, the thinner being easily indented with the finger nail.

The lower surface was variable in color, with distinct olivaceous shades in three of the six specimens. The pore surface of the very young specimen sent out as *australe* by Theissen (*254*) approached light buff (R) with an olivaceous cast; others were near deep olive buff (R) discolored Natal brown (R), one having olive-ocher (R) at the margin of growth superimposed on the pores of a good-sized sporophore; still others were wood brown (R) to snuff brown (R).

The ungulate specimen had three indistinct pore layers corresponding with the "steps" of the upper surface; the pores were continuous, however, and not interrupted by a sterile layer. The remaining specimens showed but one layer. Their color in section was quite uniform, near dark vinaceous drab (R) or somewhat paler. The length varied from 4 millimeters to 2 centimeters.

In shape the pores (Plate 22, fig. 12) varied from circular to angular, more usually circular to subangular, with dissepiments medium to thick and entire, occasionally thin and slightly eroded. They varied in size about 50 per cent (ratio 1 : 1.5), and from 4.8 to 5.8 per millimeter, the average of thirty measurements on five specimens being 5.2 per millimeter.

Five representative specimens were examined for ratio of pore-wall thickness to diameter of opening. The walls varied from 70 to 375 μ and the openings from 111 to 306 μ, the average ratios being 1 : 0.80, 1 : 0.84, 1 : 0.93, 1 : 1.17, and 1 : 1.93, respectively.

The spores (Plate 33, figs. 3 and 4) were typical in color, deep olive buff (R) to dark olive buff (R) under high power, the young ones being somewhat paler. The striæ varied from rather fine to coarse, usually moderately coarse, distinct. Those from the crushed mount averaged 6.08 by 9.72 μ for fifty measurements on five specimens, while eighty measurements from the upper surface of four specimens gave an average of 6.89 by 10.38 μ.

Two of the collections (Plate 4, figs. 1 to 3, 8 and 9) studied resemble *testaceum* Lév., which will be discussed in a forthcoming paper. They were all forwared by Father Rick as *Ganoderma applanatum*, with the exception of Theissen's exsiccata, which was distributed as *Ganoderma australe* Fr.

The current views on Léveillé's species are presented on page 506.

SPECIMENS EXAMINED

Rio Grande do Sul, *J. Rick, herb. Humphrey 11055, 11057;* Nova Petropolis, *J. Rick, herb. Humphrey 10754, 11058;* Parecy, *J. Rick, herb. Humphrey 11054;* S. Leopoldo, *J. Rick, Theissen Decades fungorum brasiliensium 254.*

AFRICA: UGANDA

One specimen from Uganda, 12 centimeters wide, 8 centimeters long, was available. This was of the applanate form, of light weight, near snuff brown (R) above with obscure zones of slightly darker color, lightly sulcate, somewhat rugose, margin pale.

Context corky, near bay (R), 2 centimeters thick, with a few harder streaks intermediate between brown and fawn color, obscurely zoned.

Lower surface near buffy brown (R) tinged with olive buff (R) in places, particularly at the margin, avellaneous (R) where bruised. Pores (Plate 22, fig. 11) angular, 4 to 4.5 to a millimeter, averaging 4.2, quite variable in size. Dissepiments thin, slightly eroded.

Spores (Plate 33, fig. 5) typical, with moderately coarse striæ, 6.4 by 8.5 μ from the crushed mount, 6.1 by 8.9 μ from the upper surface.

SPECIMEN EXAMINED

Gunda Forest, Entebbe, *T. D. Maitland 377* (H).

CEYLON

One-half of a specimen (Plate 4, figs. 11 and 12) originally 22 centimeters wide, 12 centimeters long, was available through the courtesy of the Botanical Garden at Peradeniya. This was a typical, applanate, strongly sulcate form banded with cinnamon-drab (R) and lighter and darker shades, with a buff somewhat rounded margin.

Context corky, russet, concentrically zoned, with only traces of the harder black streaks, 5.5 centimeters thick at the gibbous base, thinning to 6 millimeters at mid-length.

Lower surface near buffy brown (R) except for paler areas, bruising to Verona brown (R). Pores up to 1.5 centimeters long, near snuff brown (R) in longisection, subangular to angular, rather regular in size, averaging 4.8 to the millimeter. Dissepiments medium, for the most part entire.

Spores near deep olive buff, with moderately coarse distinct striæ, averaging 6.3 by 9.6 μ from the crushed mount.

Another specimen (Plate 4, figs. 13 and 14) labelled "*Fomes annularis* Lloyd, stratose form of *Fomes applanatus* P." was also received from Peradeniya. This was an ungulate form 10 centimeters wide, 5 centimeters long, 4 centimeters thick, with a thin context of the same general color as the other specimen. Pores also of the same color in longisection, not stratified, with mouths somewhat larger, 4 to the millimeter. Spores olive buff to deep olive buff, with moderately rough distinct striæ, averaging 7.0 by 9.5 μ. We are inclined to leave this in *applanatum* as a minor form until more is known about *annulare*.

SPECIMENS EXAMINED

Herb. Peradeniya 4960, and unnumbered specimen labelled *Fomes annularis*.

DUTCH EAST INDIES

Among the Ganodermas loaned for study by the Buitenzorg Botanical Garden there were two comparatively young ones which are distinctly referable to *applanatum*. One of these (Plate 5, figs. 1 and 2), from Sumatra (*2654*), was determined by van Overeem as *Fomes oroflavus* Wilson, the other was unnamed and was entirely devoid of spores, although having a layer of short pores up to 5 millimeters long.

The fertile specimen from Sumatra was of the "vegetus" type, originally probably 18 to 20 centimeters wide but only 7 centimeters long, 4 centimeters thick behind, tapering to a thin blunt margin. Upper surface irregularly sulcate, quite uneven, somewhat rimose, near snuff brown (R) with a buffy margin, dark brown behind.

Context corky, near to russet, distinctly concentrically zoned, with two hard black streaks in the sterile tissue, which is up to 1 centimeter thick between the two pore layers.

Lower surface suffused with isabella color (R), chocolate (R) where bruised.

Pores 5 to 7 millimeters long, angular, averaging 4.2 to a millimeter, often larger by coalescence. Dissepiments thin, considerably eroded.

Spores atypical for the species, deep olive buff to dark olive buff, 6.1 by 8.3 μ, with coarse, short, very distinct striæ, like variety *tornatum*.

The specimen is quite like certain of the Chinese and Philippine collections which, likewise, are rather young and with atypical spores.

SPECIMENS EXAMINED

Borneo, W. Koetai, *F. H. Endert* (*1675*) *6216* (Bg); Sumatra, Fort de Kock, on dead trunk of *Ficus benjamina, Ed. Jacobson* (*187*) *2654* (Bg).

PHILIPPINE ISLANDS

Comparatively few of the Philippine collections are referable to the base species and these are rather of a miscellaneous lot coming usually from the higher altitudes. There are specimens which closely match certain of the irregular thick forms from the United States, while others closely match Chinese and Japanese material. The distinction between the base species and variety *philippinense*, which is very common in the Philippines and approaches the broadly applanate forms of *applanatum* more closely than does any other variety, is rather difficult at times as there is a very wide variation within the variety. Inasmuch as the spores may not be a safe criterion, those specimens with the black context streaks so typical of *applanatum* are placed there, while specimens having distinct softer fawn-colored ones are placed in the variety. In its typical form, however, the variety is very easy to segregate by means of other characters. One specimen from Australia (*5990*) referred in the present paper to *applanatum* bore a very close resemblance to a specimen from the Philippines referred to the variety, but had somewhat larger spores and black streaks mixed with fawn-colored ones in the context. Another specimen from Australia (*Cleland 14*) showed a similar tendency (Plate 3, figs. 5 and 6) and for the same reasons was referred to the base species.

The Philippine specimens of *applanatum* (Plate 5, figs. 3 to 16) vary in shape from thick irregular tuberculose forms to small subungulate or applanate ones. Upper surface sulcate to subsulcate, often quite uneven, varying in color from pale grayish (approaching smoke gray (R) to near neutral gray (R) or even darker), with the browns represented by wood brown (R), snuff brown (R), and Natal brown (R); bruising at times to chocolate (R).

Context corky to woody, comparatively thick for the length of the pores, usually 1 to 2 centimeters, russet to bay, usually concentrically zoned. One specimen with a bay context had the layer just beneath the crust and the upper portion of the pores bleached to whitish. Hard black streaks were present in all except one very young specimen. They were usually quite noticeable.

Lower surface pallid to near ochraceous buff (R) or medium shades of brown, occasionally dark brown.

Crust varying from thin, soft and easily indented with the finger nail, to hard and up to 1.5 millimeters thick.

Pores (Plate 22, fig. 13) circular to angular, usually subangular, ranging from 4.5 to 6.0 to a millimeter for seven representative specimens, the average for the 42 measurements being 5.2. Dissepiments thin to thick, entire to somewhat eroded.

Seven representative specimens were examined for ratio of pore wall thickness to diameter of opening. The walls varied from 14 to 167 μ and the pores from 70 to 208 μ, the average ratios being 1 : 1.16, 1 : 1.20, 1 : 1.88, 1 : 1.92, 1 : 1.96, 1 : 2.13, and 1 : 4.80, respectively.

Spores (Plate 33, figs. 6 to 8) deep olive buff to dark olive buff when apparently mature, near olive buff when young, with fine to coarse, usually distinct, striæ. Those from the crushed mount averaged 5.29 by 8.35 μ for one hundred twenty-two measurements on thirteen specimens, while those from the upper surface of two specimens, one of which had spores considerably larger than usual, averaged 6.4 by 10.2 μ.

Nearly all the specimens here referred to *applanatum* are comparatively young, often rather abortive. This influences the spore characters to such an extent that they were rarely typical of the species. Some of the collections had spores that could readily be referred to variety *tornatum*, and even in the same crushed mount the *tornatum* and *applanatum* types were mixed. It is believed that these aberrant forms are a transition between the species and its variety, but on account of the thick typical *applanatum* context they have been referred to the base species. The same intermediate type of spore was found in some of the Chinese and Japanese specimens, particularly in the younger ones. More high-altitude collections must be made in the Philippines before definite conclusions can be drawn as to the normal structure and appearance of fully mature sporophores.

SPECIMENS EXAMINED

LUZON, no locality given, *Father Sanchez 16195, 45860, 45861, 50097;* Benguet Province, Santo Tomas, *M. S. Clemens 6315, C. J. Humphrey 50100,* Pauai, *R. C. McGregor 8734;* Camarines Sur Province, Mount Isarog, *G. Edaño 50099;* Laguna Province, Mount Banahao, above Majayjay, *R. C. McGregor 50102;* Nueva Vizcaya Province, Bambang, *M. S. Clemens 4391;* Pampanga Province, Mount Arayat, *R. C. McGregor 42071;* Zambales Province, Castillejos, *M. S. Clemens 3289.* Palawan, Iwahig River, near Mount Mantaliñgahan, *Buenaventura Reyes 50101*; Panay, Antique Province, *R. C. McGregor 32664,* Capiz Province, Mount Salibongbong, *A. Martelino and G. Edaño 50098.*

GANODERMA APPLANATUM (Pers.) Pat. var. BROWNII Murr.

This species was described by Murrill[158] in 1915 from California, under the name *Elfvingia brownii,* where it grows on both living and dead *Umbellularia californica* and *Quercus agrifolia.* C. F. Baker collected it in 1901, near Palo Alto, California, and sent it to Peck, then New York State botanist, who determined it as *Fomes applanatus* Pers., under which name it was distributed in *Baker's Pacific Slope Fungi 339.* The senior author made two collections at Berkeley, California, on *Umbellularia* and *Quercus* in 1909 and referred them, likewise, to *Fomes applanatus.* In 1914, H. A. Lee collected the same thing at Berkeley; this specimen is deposited in the University of California herbarium, *1036.* In 1915, the senior author found it again in abundance at Berkeley. In all, ten collections from California are at hand for study. In addition to the Californian material the senior author would also refer to this variety Bornmuller's *Plantae Exsiccati Canarienses, 1900, 45* (Univ. Wisconsin herb.) distributed from Teneriffe as *Polyporus australis* Fr.

The plant (Plate 6) is thick, ungulate to compressed-ungulate, sessile, broadly attached, often with the margin sulcate-truncate, or in young specimens blunt to rounded.

Upper surface slightly to distinctly sulcate, somewhat rugose, near snuff brown (R) in young specimens, becoming between mouse gray (R) and deep mouse gray (R) in old ones. Margin nearly concolorous but may be of a lighter shade in young specimens.

Crust (Plate 29, fig. 2) usually very distinct, blackish, hard, in older specimens ranging between 1 and 3 millimeters

[158] Western Polypores (1915) 29.

thick, cracking in age and tending to flake away. In young specimens, however, it may be comparatively thin (about 0.5 millimeter), occasionally entirely lacking at or near the growing margin.

Context corky, very thin or thick, from 4 millimeters to 4 centimeters, varying in color from Mikado brown (R), in young specimens, to chestnut (R) or bay (R). Young specimens have a distinct silky sheen on smooth cuts. Zonation usually lacking where the context is thin and present where thicker. The hard black lines so conspicuous in *applanatum* are not usually very noticeable in this variety or may be entirely lacking or replaced by softer poorly developed lighter ones similar to those in variety *philippinense* of the East.

The lower surface in dry unsublimated specimens may be somewhat flavous, passing through avellaneous (R) to somewhat darker than snuff brown (R), or even blackish discolored; brown on bruising.

The pores (Plate 23, fig. 1; Plate 25, fig. 3; Plate 30, fig. 2; Plate 31, fig. 3) are comparatively long, up to about 2 centimeters, indistinctly layered, with a total length up to 6.5 centimeters. They offer nothing distinctive in color, varying around benzo brown (R) and Verona brown (R). The mouths may be circular to angular, more commonly subangular. The walls vary from medium to thick, with entire edges. In size they may vary up to 100 per cent in the same specimen, averaging 3.9 to 4.7 to a millimeter, with an average of 4.3 for the series of seven specimens.

Seven specimens were examined for ratio of pore-wall thickness to diameter of pores. In seventy measurements the walls varied from 70 to 417 μ and the openings from 139 to 417 μ, the average ratios for the seven specimens being 1 : 0.85, 1 : 0.91, 1 : 1.06, 1 : 1.06, 1 : 1.32, 1 : 1.40, and 1 : 2.10. The walls, therefore, may be somewhat thicker, nearly equal to, or less than one-half the diameter of the opening.

The spores (Plate 33, figs. 9 to 12) when young are from olive buff to deep olive buff, the mature ones being deep olive buff to dark olive buff, with fine to coarse distinct striæ, for the most part coarse. They are the largest in the *applanatum* group, the average for crushed mounts from nine specimens (one hundred thirty measurements) being 7.60 by 11.62 μ and for spores from the upper surface of three specimens (thirty measurements), 7.92 by 12.46 μ. The spores in the Javan specimen (Plate 33, fig. 12) average 9.2 by 13.2 μ from the crushed

mount; in Baker's *Pacific Slope Fungi 339* they average 9.6 by 13.0 μ.

SPECIMENS EXAMINED

UNITED STATES, California, Berkeley, University campus, on living *Umbellularia californica, C. J. Humphrey, "A," "B," 3199, 3200, 4575* (H), on dead stub of *Quercus agrifolia, 5972* (H); San Francisco, Muir Woods, *Mrs. C. J. Humphrey, "C"* (H); Santa Clara County, foothills near Stanford University, on living *Quercus agrifolia, C. F. Baker 339* (B).

Canary Islands, Teneriffe, *J. Bornmuller, Pl. exs. canarienses 1900, No. 45.*

Java, Buitenzorg, Botanical Garden, on stem of *Cinnamomum, C. van Overeem 161* (Bg).

GANODERMA APPLANATUM (Pers.) Pat. var. LAEVISPORUM Humph. var. nov.

At the higher elevations in the Philippines there occurs a distinct variant of *applanatum* with the mature spores entirely devoid of striæ in the walls. Although other forms or varieties of *applanatum* in the Orient, particularly *tornatum,* may have some nonstriate spores occasionally mixed with striate ones in young specimens, this variety is different in having no trace of striæ either when derived from the crushed mount or when taken from the upper surface. It is an established condition, therefore, worthy of a separate varietal name.

The two specimens mentioned under the discussion of Japanese collections of *applanatum* are analogous and may eventually require segregation, but the general characters of the sporophores are too near *applanatum* to justify the writer in separating them at present. The Philippine and Javan collections fall into a definite category on other characters also. There is still another smooth-spored variant of *applanatum* of the form of *annulare* Lloyd, but since we have not yet seen the type of *annulare* this variety will not be treated until a later paper.

The variety under discussion (Plate 7; Plate 29, fig. 3) is sessile and varies from thin and applanate to compressed ungulate. The largest specimen is 5.25 inches wide and shelving for 2.5 inches. The maximum thickness at the base is 4 centimeters, but young, thin, applanate specimens are less than 1 centimeter.

The upper surface is somewhat convex to nearly plane, lightly sulcate, nearly even, occasionally finely rimose, nearly unicolorous, varying from pale brown to Sayal brown (R) or Verona brown (R). Margin subacute to abrupt and sulcate.

The context (Plate 26) is corky, or quite hard just beneath the crust, Verona brown (R) to auburn (R) or bay (R), frequently tinged with clay color (R) just beneath the crust; maximum thickness 2 centimeters at the base of one specimen but the other specimens are less than a centimeter and frequently only 3 to 4 millimeters. It is one of the thin context forms like *tornatum* in which the context is well supplied with distinct hard black streaks and not concentrically sulcate.

The under surface is quite variable. Young specimens may be near chamois (R). Others fluctuate from between avellaneous and wood brown (R) to near buffy brown (R). In one of the collections the color is light grayish olive (R). A peculiarity of several is that they bruise to a light vinaceous gray (R) or purplish.

The pores (Plate 23, figs. 2 and 3; Plate 26; Plate 30, fig. 3; Plate 31, fig. 4) in longisection are quite uniformly Verona brown (R). They are usually subangular to angular, occasionally circular, with the dissepiments thin to medium, entire to somewhat eroded. They are fairly uniform in size and average 5.5 to the millimeter for thirty measurements on five specimens from different collections. The walls range from 7 to 70 μ in thickness and the pores from 83 to 208 μ in diameter, the average ratios for seven specimens being 1 : 2.67, 1 : 3.00, 1 : 3.30, 1 : 3.36, 1 : 3.87, 1 : 3.93, and 1 : 5.90, respectively. The pores, therefore, are much greater in diameter than the thickness of the walls.

The spores (Plate 34, figs. 1 and 2) in Philippine material are usually abundant, ovate, with no trace of striæ, and vary in color in potash mount under the high power of the microscope from olive buff to dark olive buff. Those from the crushed mount average 4.97 by 8.62 μ (fifty measurements from five collections) while the ones from the upper surface are 5.69 by 8.92 μ (forty measurements from four collections.) The spores in the Javan specimen average 5.3 by 8.9 μ.

An anomalous condition exists in two of the collections. In *705* from Java are two specimens which, except for the thinner-walled pores, color of context, and spores, would unquestionably be considered the same. The one has a russet context, thick-walled pores, which are near dark vinaceous drab in longisection, and striate spores, 6.1 by 9.3 μ, and must be referred to *tornatum* forma *macrospora* of the present classification. The other (Plate 7, figs. 18 and 19) has a Verona brown context, rather thin-walled pores somewhat paler than the context, and

smooth spores, 5.3 by 8.9 μ, and is referable to variety *laevisporum*. In Bureau of Science collection *7637* from Mount Apo, Mindanao, one specimen can be separated from the other three on exactly the same characters. Of these three, one specimen has spores that are just beginning to form striæ; in the others the spores are more mature and distinctly striate. Those plants with striate spores are referable to *tornatum* forma *macrospora*. There is no direct evidence that the two kinds of sporophores were directly associated in nature but if so the situation is rather novel. There are too many instances of mixed collections, however, to warrant an assumption one way or the other.

Of the specimens cited, *50084* and *50085* are designated types of the variety.

SPECIMENS EXAMINED

JAVA, West Java, Tjibodas, G. Gedeh, *C. and D. van Overeem de Haas, Dakkus, Bruggeman and W. D. van Leeuwen 705* (*pro parte*) (Bg).

PHILIPPINE ISLANDS, Luzon, Mountain Province, Benguet Subprovince, Baguio, *E. B. Copeland 1039*, on *Pinus insularis*, *1303* (B), Haight's Place, *50085*, Pauai, *8738;* Bontoc Subprovince, Mount Data, mossy forest, *M. S. Clemens 50084*, along high forest trail, on *Quercus jordanae?*, *M. S. Clemens 50086*. Mindanao, Davao Province, Mount Apo, *M. S. Clemens 7637* (*pro parte*).

GANODERMA APPLANATUM (Pers.) Pat. var. PHILIPPINENSE Humph. var. nov.

Practically all the broadly applanate sessile variants of *applanatum* in the Philippines fall in the two varieties *tornatum* and *philippinense*, of which the latter may well be considered an analogue of the North American form of *applanatum*, although it is considerably more variable. The two varieties mentioned can, as a rule, easily be segregated on one or more of several characters. Separation of *philippinense* from the base species, however, is more difficult and there are forms referred to the variety in the present paper upon which all investigators might not agree as to the propriety of segregation. However, since we are primarily dealing with a Philippine thing that in its usual development is sufficiently marked as a strong variety it is better to err by placing in the variety those forms that approximate the base species rather than to broaden the limits of the base species and thus increase the difficulties of interpreting between the two locally. In other words, this is a case where geographical considerations can be invoked to clarify somewhat the nomenclatorial situation.

In discussing variety *philippinense* as here constituted the writer is constrained to include within it forms that show very wide end variations, since these all run together in any reasonably large series of collections. One could easily pick out three or four of the most distinctive forms that mycologists not conversant with Philippine variations would probably not hesitate to consider distinct species, or might even refer to certain of the older species. Should the writer attempt to segregate them at present it would be as forms rather than varieties, and forms in the *applanatum* group are too numerous to warrant encumbering the literature. Various workers who have identified material for the Bureau of Science and the Baker herbaria have given different interpretations. Bresadola has consistently referred such Bureau of Science specimens as he saw [*10556* (Plate 8, fig. 6; Plate 34, figs. 5 and 6)' *13751*, *16634* (Plate 9, fig. 6), *19239*] to *Ganoderma subtornatum* Murr., except *10538*, which he placed in *megaloma* Lév. Elmer distributed as *Fomes gibbosus* (Bl. and Nees) Pat. (*14255*) a very young stipitate atypical specimen whose affinities lie with the variety. Lloyd has used various specific names such as *applanatum* Pers. [*35867* (Plate 12, fig. 9; Plate 23, fig. 9), *35998* (Plate 8, fig. 7)], *australe* Fr. [*16634* (Plate 9, fig. 6), *19239*, *35999* (Plate 8, figs. 3 and 4), the first two being *subtornatum* for Bresadola], *fasciatum* Lév. (*28308*), *koningsbergii* Lloyd (*2094* from Borneo), *leucophaeum* Mont. [*35977*, *35997*, *36094* (Plate 8, fig. 5)], *oroflavus* Lloyd [*36046* (Plate 14, figs. 5 and 6; Plate 27, fig. 2), *36097*], *tornatum* Pers. [*36007* (Plate 9, fig. 5)], *Fomes lamaoensis* Murr. (*Baker 29*), and *Fomes pachyphloeus* Pat. (*Baker 460*). Murrill referred his specimens to *Elfvingia tornata* (Pers.) Murr. (*167*, *8932*), the latter number being *koningsbergii* for Lloyd. Patouillard used the following names in the Baker herbarium; *australe* Fr. (*659*, *3353*), *leucophaeum* Mont. [*670*, *714* (Plate 8, figs. 15 and 16), *763*, *4215*, *4381*], and *mastoporum* Lév. (*762*). Sydow placed one small grayish specimen (*18388*) in *testaceum* Lév. (Plate 9, figs. 10 and 11). It is hoped that the illustrations (Plates 8 to 14; Plate 29, fig. 4) will serve to convey to the reader a better conception of these forms than can be gained from the general description that follows.

In the commoner form the plants are applanate, nearly plane to broadly convex, and sessile. Distinctly laterally stipitate forms frequently occur, however, the stipe being long and torulose at times (Plate 11, figs. 1 to 4), often curving downward when attached to roots. The earliest stages of growth (Plate

9, figs. 12 and 13; Plate 12, figs. 6 to 8) often appear as hemispheric, subglobose, compressed-ungulate, or ungulate masses of compact sterile hyphæ, which may reach a thickness of 8 centimeters. Other young stages that are beginning to take on the applanate form may be somewhat concave above (Plate 10, figs. 5 and 6). Ultimately the sporophores attain a large size and are conspicuous in the forest, the largest specimen at hand being 15 inches long and 22.5 inches broad, although larger ones are not unusual.

The upper surface is characteristically tuberculose, occasionally radiately grooved, frequently somewhat sulcate but usually not strongly so. The color usually ranges from pale brown to dark brown, although occasional specimens may vary from pale smoke gray (R) and smoke gray (R) to shades of drab, or even blackish (Plate 17, fig. 9). In this respect they are not much different from the base species. Some of the younger specimens, however, which are considered by Patouillard as *Ganoderma leucophaeum*, are quite distinctive, the extreme margin being light buff (R), followed by deep purplish gray (R) shades (Plate 8, figs. 15 and 16). These latter shades have not been observed in the base species.

The context usually varies from soft corky to corky, often quite hard behind, its color being usually around russet (R). The lightest shades noted were near fawn color (R) and avellaneous (R) and the darkest were auburn (R) to near chocolate (R). Other intermediate shades are cinnamon (R), Sayal brown (R), Verona brown (R), and army brown (R). As a rule the colors in a single specimen are not uniform but consist of two or more, shading one into the other, the shade next to the pore layer usually being the darker. Indistinct to striking concentric bands of lighter and darker tissue are frequently present. The harder black radiating streaks so common in *Ganoderma applanatum* are sparingly represented. Many specimens, however, have more or less radiating streaks or distinct bands of tissue that are near fawn color (R) and only slightly harder than the surrounding darker tissue. Being more abundant at the base they tend to make the tissue in that region firmer. Other specimens may be devoid of streaks of any character, particularly the younger ones.

One fairly constant feature of the context is the presence of distinct whitened flecks or areas from the size of a pin head to several millimeters. These vary around cartridge buff (R) or may be more ochraceous. They are frequently associated with

cavities, apparently produced by insects, and take the form of isolated more or less circular areas or somewhat elongate streaks running in the direction of the fibers, or concentrically along the zones. Occasionally they are sufficiently numerous to coalesce and give a distinct bleached effect to the context. These bleached areas consist of very fine hyphæ, colorless under the microscope (Plate 28).

The pore surface when fresh may be nearly white in some specimens, brownish on bruising, while sporophores growing adjacent to them may vary from deep purplish gray (R) to blackish slate (R). The light surfaces darken somewhat in drying and the dark ones become somewhat lighter. The light-colored ones range from pallid brownish to wood brown (R) and Verona brown (R). One young specimen was near light buff (R) and young superimposed growth on the under surface of an old black sporophore was near tawny olive (R). Occasionally the same sporophore will be pallid brown on the outer portion and benzo brown (R) to near Verona brown (R) behind. When dry the dark under surface varies around mouse gray (R), deep brownish drab (R), and fuscous (R).

Photomicrographs of sections made at the extreme tips of the pores of type specimens having light and dark under surfaces (Plate 27, figs. 4 and 5), respectively, show that the tissue of the light ones is composed of thin-walled, rather fine, closely interwoven, colorless hyphæ, while in the dark ones rigid, thick-walled, more or less parallel, brown hyphæ extend to the very end of the dissepiment, pushing through a narrow zone of the colorless ones. This differentation of hyphæ at the tips apparently indicates a more mature condition of pore development and may be considerably influenced by climatic conditions prevailing at different stages of growth.

The pores in longisection (Plate 27, figs. 1 to 3; Plate 31, fig. 5) may be corky in young specimens and hard in older ones; in general they are harder than those of *Ganoderma applanatum* from the United States and Europe but do not differ from Japanese and Brazilian material in this respect. The color is fairly uniform. Young partially developed layers may be avellaneous (R); older ones vary around Verona brown (R) and Mars brown (R) to benzo brown (R). Occasionally they become bleached.

In shape the pores (Plate 23, figs. 4 to 17; Plate 30, fig. 4) vary from circular to angular, in large part subangular, with thin to thick dissepiments (more commonly medium to thick),

usually entire, occasionally slightly eroded. The openings frequently vary 100 per cent in size (ratio 1 : 2). The number per millimeter varies from 4.9 to 6.1 (only one with this high count, the next highest being 5.8), the average for one hundred twenty-six counts on twenty-one different sporophores (with the exception of two, from different collections) being 5.4.

Thirteen representative specimens were examined for ratio of pore-wall thickness to diameter of opening. In one hundred twenty measurements the walls varied from 42 to 348 μ and the openings from 83 to 348 μ, the average ratios for the thirteen being 1: 0.50, 1: 0.69, 1: 0.74, 1: 0.77, 1: 0.77, 1: 0.83, 1: 0.85, 1: 1.04, 1: 1.26, 1: 1.39, 1: 1.46, 1: 1.64, and 1: 1.72.

There is a very hard form (Plate 14, figs. 1 to 3, and 7) of this variety that is occasionally found in various parts of the Islands. This offers nothing distinctive in shape or lower surface characters, although the upper surface tends to the more somber shades of brown to blackish. The context, however, becomes very hard and has a generally yellowish brown appearance, due to a higher percentage of tawny olive (R) and cinnamon brown (R) in the blend of colors; there is occasionally, however, a minor proportion of russet characteristic of the typical forms of the variety. There are up to two layers of pores in the specimens at hand, but these fall well within the limits of the variety in hardness, shape, and size. The spores (Plate 34, fig. 8) are the same.

Another distinct form (Plate 14, figs. 4, 8, and 9; Plate 34, fig. 9) is large, applanate, sessile or with a short, horizontal, lateral stipe. Context typical. Upper surface with a thick hard crust that becomes shining black on rubbing but is dusted with fawn-colored to wood brown spores and other fine particles. The pore surface (Plate 23, fig. 12) is near light grayish olive (R) to near mouse gray (R), bordered all around by a sterile brown band 5 millimeters to 2 centimeters wide. This broad sterile margin is a rather unusual feature, but is present to a lesser degree in other specimens of the variety.

Specimens that the writer takes to be a young condition of the variety (Plate 13, figs. 1 to 11) are rather light weight with a thin brownish to black crust easily indented with the finger nail, the upper surface being somewhat finely rimose, somewhat sulcate, occasionally lightly tuberculose, and variously obscurely banded with shades of smoke gray, drab, and benzo brown (R). The pore surface is always whitish when fresh, indicating a young growing stage, but becomes very pale brownish to near

wood brown (R) on drying; buffy brown (R) to chocolate on bruising. The context varies from cinnamon (R) and Sayal brown (R) to russet and is soft corky, with black streaks very rare and the fawn-colored ones scarcely represented.

Three large typical specimens of the variety from the Federated Malay States (Plate 11, figs. 3 to 7, 9, and 10; Plate 34, fig. 12) were represented among the Ganodermas loaned by the Singapore Botanical Garden. One of the two applanate specimens had the usual dark under surface; the lower surface of the other was near cartridge buff (R). The third specimen (Plate 11, figs. 3 and 4) was younger, with a nearly circular, slightly concave pileus about 14 centimeters in diameter and an ascending torulose stipe 5 centimeters thick at the base, 3.5 centimeters at the top. Upper surface lightly sulcate, not tuberculose, with a thin brown crust zoned with light buff (R) at the edge and alternating bands of wood brown (R) and vinaceous drab (R) behind. Context corky, harder at the base of the stipe, distinctly concentrically zoned throughout pileus and stipe, of a general russet color with suggestions of ochraceous tawny just beneath the crust, 5 centimeters thick at the gibbous attachment of the stipe, with abundant fawn-colored streaks throughout the stem but not in the pileus proper. The stipe was distinctly tuberculose, near cinnamon drab (R) below and near light mouse gray (R) above, covered by a dark brown to blackish, glabrous, dull crust. Under surface light buff with a brownish tinge, with circular to subcircular thick-walled pores 9 millimeters long and averaging 5 to the millimeter, devoid of spores.

The senior author is of the opinion that such forms as these are what Blume and Nees [159] described and figured in color from Java as *Polyporus gibbosus*, but they certainly cannot be distinct from the strictly sessile broadly applanate forms that are much commoner. The type probably not being in existence it is impossible to determine just what Blume and Nees had in hand. Nothing to closely match their figures has ever been seen by the writers, and if at all common it would probably be represented in the Buitenzorg collections. It seems advisable, therefore, to drop the name.

The two specimens in the senior author's herbarium from Java are rather doubtfully referred to *philippinense*. Both are comparatively young and could with nearly equal propriety be

[159] Fungi Javanici, in Nova Acta Acad. Caes. Leop. 13 (1826) 19, pl. 5.

left in the base species. In fact Dr. E. A. Burt has identified *5479* (Plate 12, fig. 12) as *applanatum*. Further collections from Java are necessary before it can be decided whether the variety is properly represented in the Dutch East Indies.

The spores (Plate 34, figs. 3 to 12) of variety *philippinense* are very similar to those of the base species, varying under the microscope (high power) from olive buff to dark olive buff, for the most part with fine to moderately coarse, quite distinct, striæ. Occasionally a specimen has somewhat coarser ones. They are thus similar in these respects to the spores of many collections of *applanatum*, particularly those from the United States. They are frequently collapsed when taken from dry specimens, but this is nothing distinctive. In fact, the spores of many specimens of *applanatum*, those of *mastoporum*, of variety *philippinense*, and of *tornatum* forma *macrospora* are too much alike to separate by any descriptive terms.

Measurements made on variety *philippinense* from the Philippines gave an average of 5.43 by 8.77 μ for 534 spores from the crushed mounts of 47 collections, while those from the upper surface averaged 6.16 by 9.45 μ for 360 measurements from 34 collections. The two specimens from the Federated Malay States gave 5.8 by 8.9 μ from the crushed mount of one and 5.9 by 9.1 μ from the upper surface of the other.

Bureau of Science 50047 is designated as the type (Plate 9, fig. 15; Plate 10, figs. 1 to 7; Plate 23, figs. 5 and 6; Plate 27, figs. 4 and 5) since at least four of the principal forms are represented among the several sporophores. No. *50048* may be considered as supplementary to represent more fully the form with dark under surface.

In his paper on New Zealand Polyporaceae Cunningham[160] recognizes three species and one variety of the *applanatum* group; namely, *Fomes applanatus* (Pers.) Gillet, *Fomes australis* (Fr.) Cke. and its variety *oroflavus* (Lloyd), and *Fomes subtornatus* (Murr.) Lloyd. He distinguishes between them on the relative size of the pores, stating that the walls of the tubes are 0.09 to 0.1 millimeter (90 to 100 μ) thick in *applanatum* and *australis*, with tubes 0.18 to 0.2 millimeter (180 to 200 μ) in diameter in *applanatum* and 0.27 to 0.3 millimeter (270 to 300 μ) in *australis*. In *subtornatus* the walls are given as 0.2 to 0.25 millimeter (200 to 250 μ), with no data on the diameter of the tubes. The writer has attempted to apply these

[160] Trans. N. Z. Institute 58 (1927) 214–218.

criteria to the various species and varieties described in the present paper, the data being presented under the respective names. With the exception of *subtornatum*, all of Cunningham's figures fall within the limits of any of the species or varieties described, except *applanatum* from Australia, but including *applanatum* from Europe. Likewise our figures cannot be considered of diagnostic value in differentiating species or varieties. It may also be remarked that Cunningham's *Fomes australis* is not the same as our *tornatum*, which has considerably smaller spores. Likewise his *Fomes subtornatus* differs in spore characters from anything the senior author has seen, although the illustrations seem to agree fairly well with what we consider variety *philippinense*.

SPECIMENS EXAMINED

BRITISH NORTH BORNEO, Sandakan, Sibuguey, *M. Ramos 2094*.

FEDERATED MALAY STATES, Johore, Pontian Road, on fallen trunk in rubber plantation, *E. J. H. Corner 23225* (S); Pahang, Bantong, on an old stump, May, 1930, *E. J. H. Corner* (S), Fraser Hill, E. J. H. Corner, *23229* (S).

JAVA, Buitenzorg, on *Acacia decurrens, Carl Hartley 5479* (H); West Java, on *Vernonia arborea, Carl Hartley 5410* (H).

PHILIPPINE ISLANDS, BASILAN, Isabela, *H. S. Yates 35998, 35999, 36007, 36046, 36094, 36097, 36116*. BILIRAN, *R. C. McGregor 18388*. LUZON, no locality given, *Father Sanchez 45881, 50063;* Albay Province, Catanduanes Subprovince, *M. Ramos 50076;* Bataan Province, *H. M. Curran, Bureau of Forestry 19239,* Mount Mariveles, *C. J. Humphrey 50077,* on *Shorea guiso* (Blco.) Blm., *C. J. Humphrey 50048, 50069, 50070, C. J. Humphrey and L. Reyes 50094,* on *Pentacme contorta, C. J. Humphrey and L. Reyes 50057,* Samal, *M. S. Clemens 1305;* Cagayan Province, *H. M. Curran, Bureau of Forestry 16634;* Camarines Sur Province, Botol River, *G. Edaño 50049;* Laguna Province, Los Baños, *C. F. Baker 659A* (B), *29* (B), *714* (B), *762* (B), *763* (B), Mount Maquiling, *C. F. Baker 3353* (B), *4215* (B), *4381* (B), on dead branches of *Parashorea plicata, J. Daproza 460* (B), *Alejandro de Mesa and Conicosa 50051, C. J. Humphrey 50044,* on *Alphonsea arborea* (Blco.) Merr., *Alejandro de Mesa and Conicosa 50042, 50043,* on *Canarium ovatum* Merr., *C. J. Humphrey 50045,* on *Diplodiscus paniculatus, Alejandro de Mesa and Conicosa 50071,* on *Parashorea malaanonan, Alejandro de Mesa and Conicosa 50046, C. J. Humphrey 50047, 50052, 50053, 50054, 50068,* on timber, *Buenaventura Reyes 50055, 50067, V.*

Serviñas 16930 (B. S.; B), Santa Maria Mavitac, *H. M. Curran, Bureau of Forestry 8932;* Mountain Province, Apayao Subprovince, Aguimi, *E. Fenix 28308* (B. S.; B); Pampanga Province, Mount Arayat, *R. C. McGregor 42075, 42078,* Stotsenburg, *M. S. Clemens 2325, 2578;* Rizal Province, Mayatagan River, *G. Edaño 50103;* Sorsogon Province, Irosin, Mount Bulusan, *A. D. E. Elmer 15986* (B. S.); Tayabas Province, *R. C. McGregor 47956,* Calauag, *O. Ladia 50124,* Guinayangan, *O. Ladia 50106, O. Ladia and Jundak 50105, O. Ladia, Jundak, and Alejandro de Mesa 50072, M. Oro 50127,* on *Dipterocarpus grandiflorus* Blanco, *O. Ladia 50058, 50062, 50109, 50110, 50118, 50122, M. Oro and Jundak 50123,* on *Livistona* sp., *M. Oro 50050,* on *Livistona rotundifolia, O. Ladia 50121,* on *Parashorea malaanonan, M. Oro and Jundak 50108,* near Kabibihan, *C. J. Humphrey 50073, 50074, 50075,* Malicboy, *R. C. McGregor 47960;* Zambales Province, Castillejos, *M. S. Clemens 3289,* Olongapo, *M. S. Clemens 4548, 4551, 50064, 50065.* MINDANAO, no locality given, *Alejandro de Mesa 50056;* Agusan Province, Cabadbaran, Mount Urdaneta, *A. D. E. Elmer 13403, 14255* (B); Davao Province, Mount Apo, *M. S. Clemens 50066;* Zamboanga Province, *C. J. Humphrey 50041, 50078, 50093,* on *Pentacme contorta, C. J. Humphrey, 50092, 50096, 12181* (H), *12184* (H), *12192* (H), *H. S. Yates 35977,* on *Pometia pinnata* Forst., *C. J. Humphrey 50095,* on *Shorea teysmanniana* Dyer, *C. J. Humphrey 12173* (H), *50079, Lumarao,* on *Palaqium* sp., *Alejandro de Mesa 50059,* on *Diospyros discolor, 50061,* Malangas, *M. Ramos and G. Edaño 36477,* Naga-Naga, *Alejandro de Mesa 50060, 50080,* on *Parashorea malaanonan, A. de Mesa, 50107, 50119.* NEGROS, Occidental Negros, Mount Marupa, *H. M. Curran, Bureau of Forestry 13751.* PANAY, Capiz Province, Mount Bulilao, *A. Martelino and G. Edaño 35882,* Mount Salibongbong, *A. Martelino and G. Edaño 35865, 35867.* POLILLO, *R. C. McGregor 10538, 10556* (B. S.; B). SULU ARCHIPELAGO, Tawitawi Island, *H. S. Yates 35943.*

GANODERMA APPLANATUM (Pers.) Pat. var. TORNATUM Pers.

After a very critical study and careful comparison of many specimens of *Ganoderma applanatum* and its variants the writers have reached the conclusion that it is unwise to continue to maintain *Ganoderma tornatum* (*australe* Fr. of many writers) as a species. In its typical form it is sufficiently distinct from typical *applanatum* from Europe and the United States but when other parts of the world are brought into consideration, with

their intermediate forms that cannot be differentiated on a structural basis, there is too much of a general resemblance to warrant specific segregation. The temperate regions of the Orient, in particular, such as China, Japan, and the higher altitudes of the Philippines, produce too many confusing forms for safe classification on the old basis. While for the majority of collections the spores are a suitable criterion, still in a certain proportion of specimens that are typical *tornatum* in appearance one finds the spores of *applanatum* and, vice versa, there are occasional collections of what must be considered *applanatum* that have spores similar to, or very close to, *tornatum*.

Cleland and Cheel [161] appear to have been the first to use the combination *Fomes applanatus* var. *australe* Fr., with reference to Australian specimens.

The senior author has a series of collections of the *applanatum* group from Doctor Cleland, and all but one are referable to the base species. The exception is placed in variety *tornatum* on the basis of its smaller typical spores, even though it is indistinguishable on other characters from *applanatum*, but it is not typical *tornatum* of the Tropics. Whether Cleland based his varietal concept on a knowledge of typical tropical forms we are unable to state. *Ganoderma australe* Fr. is apparently different from what we refer to *tornatum* since the only known type of the Friesian species has much larger spores.

Bresadola has examined the type of *tornatum* Pers. and refers to it certain Philippine[162] material with spores usually 7 to 8 by 4.5 to 5 μ and a Javan [163] specimen with spores 6 to 8 by 4 to 5 μ. These measurements accord well with our concept of the variety.

Several of the specimens from the Philippines here referred to variety *tornatum* have been variously named by other workers. Bresadola referred the specimens sent him either to *Ganoderma australe* or *tornatum* [*Bu. Sci. 193, 14376, 16028* (Plate 17, fig. 20)]. Graff used the names *applanatum* [*Bu. Sci. 14376* (Plate 17, fig. 24; Plate 35, fig. 1), *16390*] and *subtornatum* (*19234*). Lloyd employed more names than anyone else, referring specimens to *applanatum* [*Bu. Sci. 193, 14376, 16028, 19236* (Plate 24, fig. 5), *21596* (Plate 35, fig. 4), *27832, 35962, 35969, 36061; Baker herb. 3582, 3614, 3634* (Plate 19,

[161] Proc. Roy. Soc. N. S. Wales 51 (1918) 518.
[162] Hedwigia 53 (1912) 55.
[163] Ann. Myc. 10 (1912) 502.

fig. 1), *4130, 4187, 4211, 4357, 4364, 4374, 6018, 9602, 9621*], *australe* (*Bu. Sci. 16930, Baker 9796*), *gibbosum* (*Bu. Sci. 19234, Baker 5110*), *nigrolaccatum* (*Baker 9683*), *tornatum* [*Bu. Sci. 36121, 36130* (Plate 16, fig. 3)], *williamsianum* Murr. [*Baker 2955* (Plate 35, fig. 3)], and *Fomes lamaoensis* Murr. (*Baker 75*). Murrill used *Elfvingia tornata* (*Bu. Sci. 193*). Patouillard applied the four names *applanatum* (*Baker 2480, 7383*), *australe* [*Baker 512, 659* (Plate 17, fig. 25), *2518* (Plate 30, fig. 6), *3388, 3393, 3415* (Plate 35, fig. 5), *4461* (Plate 17, fig. 26)], *testaceum* [*Baker 1662* (Plate 19, fig. 5)], and *tornatum* (*Baker 2119, 2613, 2735*). Sydow determined one specimen as *australe* [*Bu. Sci. 14376* (Plate 17, fig. 24; Plate 35, fig. 1)] and one as *tornatum* (Bu. Sci. *18341*).

Of the material from the Singapore herbarium Lloyd determined two specimens. One (*8354*) he called *Fomes fasciatus* Lév., the other (*4935*) *leucophaeus*. Miss Wakefield named the Bornean specimen [*19202* (Plate 35, fig. 8)] *Ganoderma australe* (Fr.) Pat. None of the Buitenzorg specimens were determined.

The sporophores (Plates 15 to 17, figs. 1 to 8, 10 to 26; Plate 18; Plate 19, figs. 1 to 8, 11 to 17) are predominantly applanate, often rather hard and heavy, broadly convex to nearly plane, for the most part sessile, dimidiate and rather thin, usually with a thin context and relatively long pores. The shape, mode of attachment, and relative weight vary to a considerable extent, however. The thickness of the context may also show wide variation, particularly in the younger specimens; in fact, it is often quite impossible to discriminate between the species and the variety on this character, although the older typical specimens can for the most part easily be segregated by the comparatively thin context and relatively long pores.

Among the smaller specimens laterally stipitate to substipitate forms are not unusual. Sessile forms, on the other hand, may be broadly attached or effused behind for more than the length of the pileus. An occasional collection may be subungulate. In rare instances sterile hemispherical masses (Plate 19, figs. 11 and 12) may occur; one such measured 2.25 inches in diameter. These are not likely to be confused with variety *philippinense*, however, on account of their darker internal color and the presence of harder black streaks instead of the fawn-colored ones prevalent in *philippinense*.

Three of the largest Philippine specimens measured 12 by 8 by $1\frac{1}{8}$, 11 by 9.5 by 1.75, and 11 by 7.5 by 2.5 inches in width,

length, and basal thickness, respectively, while a large Malayan specimen measured 13 by 6.5 by $\frac{7}{8}$ inches. Some of the small specimens were only 0.25 inch thick. The greater number of specimens at hand showed only one or two layers of pores, these often being indistinctly separated. Occasionally a sporophore produced a new layer of pores upon the blackened surface of the old as an interrupted growth only partially covering the surface (Plate 15, fig. 2). At times this old tissue was dead and insect-riddled at the margins (Plate 15, fig. 3). Such superimposed pore layers were sometimes loosely joined, with a rather thick conspicuous vegetative layer of hyphæ between, thus producing the condition upon which *Fomes vegetus* Fr. is based.

The upper surface is lightly to strongly sulcate, for the most part rather uniform in color but sometimes obscurely zoned. It may be somewhat tuberculose or radiate rugose but this feature is not very noticeable, being masked by the strongly sulcate tendency, which immediately attracts the attention.

There is not a great variation in color, the younger specimens often being lighter in shade than the older. Here the colors range around wood brown (R), although some are close to Verona brown (R). Weathered young specimens may be near light drab (R) or near drab gray (R), with or without neutral gray (R) zones. Other young specimens may be near fawn color (R) or wood brown (R) to near snuff brown (R), often with paler brown zones or a few blackish ones. The margin may be somewhat paler, or even darker, than the general color, but this is not a conspicuous feature. Older specimens may occasionally be somewhat lighter than wood brown (R) but usually vary around Verona brown (R). Occasionally they may have a purplish gray cast.

The under surface color is highly variable, becoming darkened by weathering, bruising, or sublimating. Dried specimens collected in fresh growing condition and not poisoned with an alcoholic solution of corrosive sublimate vary from a dirty whitish with a pale vinaceous tinge to deep olive buff (R) or dark olive buff (R); on bruising they become Verona brown (R). Other miscellaneous collections vary around wood brown, sometimes paler, sometimes darker. One specimen was almost dark purplish gray (R) and still another dark purplish drab (R), which colors are common in variety *philippinense*.

The context is corky to very firm, or even hard in certain specimens where the black lines are abundant. The color varies

from sayal brown (R) to bay (R) or chestnut (R). Many are around russet (R), sometimes with paler zones. The colors, however, may be mixed in the same specimen; in one case they were sayal brown (R) above shading into bay (R), while in another both russet and bay were represented. Where differences in color exist in the same sporophore the darkest shade occurs just above the pores, but may be elsewhere as well. Obscure to distinct concentric zones are frequently present, especially in the specimens with the thicker context, and occasionally one finds small bleached spots around insect burrows, as in variety *philippinense*. Hard black streaks are almost invariably present, at least toward the base. The softer fawn-colored streaks of *philippinense* are rarely represented, and then only in association with the black ones. A black crust (Plate 25, fig. 4; Plate 29, figs. 5 and 6) is present in all specimens, varying from 0.25 to 1 millimeter thick and frequently cracked in dry specimens, often absent at the extreme margin.

The pores in longisection (Plate 25, fig. 4; Plate 31, fig. 6) vary around benzo brown (R), sorghum brown (R), Hays brown (R), and deep brownish drab (R), but the exact colors cannot be matched in Ridgway. They are frequently stuffed with white mycelium. In any case they offer considerable contrast to the context on freshly smoothed surfaces. As a rule, the dissepiments are quite similar in color to the thin dark context layer from which they arise, but the fact that the pores are pale within gives a general effect of contrast with the usually more brownish shades predominating in the context. The greatest number of layers observed was four, the maximum length being 27 millimeters. One centimeter, or a little less, is a good average figure for many of the specimens. As to hardness, the pores of some of the thin-walled younger specimens can easily be indented with the thumb nail, in this respect being similar to the usual American form of *applanatum*. Other, usually larger, specimens are firmer or quite hard, the latter being indented with difficulty.

In shape the pores vary from circular to angular, the usual condition being circular to subangular, only occasional ones being distinctly angular (Plate 24, figs. 1 to 6; Plate 30, figs. 5 and 6). The dissepiments vary from thin to thick and from entire to eroded, the greater number being medium to thick with the edges entire. The size usually varies within the same specimen from

25 to 50 per cent, but may be as high as 100 per cent. The number per millimeter varies from 4.9 to 6.4, the average for one hundred twenty measurements on twenty specimens being 5.7.

Fourteen representative specimens were examined for ratio of pore-wall thickness to diameter of opening. In one hundred forty measurements the walls varied from 28 to 348 μ and the openings from 83 to 348 μ, the average ratios for the fourteen specimens being 1: 0.40, 1: 0.93, 1: 0.97, 1: 1.24, 1: 1.36, 1: 1.47, 1: 1.60, 1: 1.75, 1: 2.16, 1: 2.26, 1: 2.51, 1: 4.23, 1: 4.51, and 1: 4.79, respectively.

The above description is drawn primarily from Philippine specimens. Material from the Dutch East Indies and from the Federated Malay States offers no further variation. One specimen from Togo, Africa, distributed by the Berlin Museum as *Fomes amboinensis* (Plate 19, fig. 6; Plate 24, fig. 6; Plate 25, fig. 4; Plate 35, fig. 11) readily falls in the variety both on spore characters and general appearance, while a single small specimen from Cuba is quite typical.

The spores (Plate 35) have a strong tendency toward elliptical, some being truncate at the distal end and a few having pointed hyaline tips. In many, however, these features are absent. Young spores are usually somewhat larger, at least longer, than the old, smooth walled or with indistinct striæ, paler in color and distinctly pointed ovate. Mature ones vary in color from olive buff to dark olive buff, but are usually the darker shades. The striæ are very distinct and moderately coarse to coarse, usually the latter. The hyaline epispore being relatively thin, the striæ are rather short, and being coarse, they gave a distinctly rough appearance to the spores. In size the spores are considerably smaller, and usually darker, than in *applanatum*.

Measurements were made of 1,078 apparently mature spores from crushed mounts of 93 Philippine collections. These gave an average of 5.03 by 7.58 μ, while spores from the upper surface of 53 specimens averaged 5.44 by 7.83 μ for 590 measurements.

Five specimens from the Dutch East Indies (Plate 19, figs. 7 and 8; Plate 35, figs. 8 and 9) averaged 5.16 by 7.62 μ for 47 measurements from crushed mounts and 5.63 by 7.93 μ for 20 measurements from the upper surface of 2 specimens.

Sixteen specimens from the Federated Malay States (Plate 19, figs. 14 to 17; Plate 35, fig. 10) averaged 5.97 by 7.83 μ for 137 measurements from crushed mounts; upper-surface spores

gave an average of 5.79 by 8.63 μ for 30 measurements on 3 specimens.

From the upper surface of the single Australian specimen (Plate 35, fig. 12) they averaged for 20 measurements 6.25 by 8.68 μ, thus being somewhat larger than normal for the variety, but altogether too small for Australian specimens of *applanatum*.

SPECIMENS EXAMINED

AFRICA, Togo, Misahöhe, *Baumann* (*ex Museo botanico Berolinensi*).

AMBOINA, *C. B. Robinson, Reliquiae Robinsonianae, Plants of Amboina, 2050* (B. S.).

AUSTRALIA, Queensland, Impie Forest, near Gympie, *J. B. Cleland* (*6*).

BORNEO, Banguey Island, *C. Boden-Klass 19202* (S.); W. Koetai, *F. H. Endert* (*2467*) *6993* (Bg), *F. H. Endert* (*2463*) *8636* (Bg).

CUBA, Ceballos, *Blanche and C. J. Humphrey 2817* (H; B. S.).

FEDERATED MALAY STATES, Johore, Gunong Pantai, *E. J. H. Corner 23238* (S); Pulau Penang, Waterfall Gardens, on stump of *Albizzia lebek*, *T. F. Chipp 4985* (S), on dead wood, *M. Noor 5616* (S); Pahang ,Tambeling, parasitic at base of *Hevea brasiliensis*, *E. J. H. Corner 23694* (S); Selangor, Kuala Lumpur, *C. Dover*, two unnumbered collections made in 1928 (S), on *Casuarina* stump, *T. F. Chipp 5673, 5677* (S), Lake Gardens, *M. Noor 5494* (B. S.); Singapore, Botanic Gardens, on dead *Bauhinia*, *Mat. 5144* (S), on rotten stump, *T. F. Chipp 5890* (S), *R. C. Holttum 11426* (S), Economic Gardens, on *Casuarina* stump, *Ethel M. Burkill 334* (S), Gardens Jungle, *R. C. Holttum 8354* (S), Woodlands, *Dr. L. Boon King 4935* (S).

JAVA, Boschproefstation, *J. W. Dorst* (*21*) *5707* (Bg); Buitenzorg, Botanical Garden, *C. van Overeem 163* (Bg), *Nongnong 5537* (Bg), *5539* (Bg).

PHILIPPINE ISLANDS, BASILAN, Isabela, *H. S. Yates 36061.* LUZON, no locality given, *Alejandro de Mesa 50125, Father Sanchez 16206, 50001, 50008, 50010;* Bataan Province, *H. M. Curran, Bureau of Forestry 19234* (B. S., B), *19236,* Lamao, on *Ficus, E. B. Copeland 193, H. A. Lee 29;* Batangas Province, Mount Macolod, *A. P. Hitchens and W. I. Kelly 50018;* Cagayan Province, Aparri, *M. S. Clemens 2845,* Mount Camiguin, *G. Edaño 50036,* Tamdagan, *G. Edaño 50037;* Ilocos Norte Province, Bangui, *R. C. McGregor 6493,* Burgos, *M. Ramos 27832;* Ilocos Sur Province, Sevilla, *M. S. Clemens 1636;* Laguna Prov-

ince, Lilio, on *Artocarpus integra* (Thunb.) Merr., *J. Conoza 50027,* Los Baños, on bamboo stumps, *C. F. Baker 512* (B), *659,* (B), *1662* (B), *2119* (B), on *Artocarpus integrifolia, 6018* (B), San Antonio barrio, on *Tamarindus indica, N. Reyes 4130* (B), Majayjay, *R. C. McGregor 50019, 50020,* Mount Banahao, on *Dipterocarpus* sp., *O. A. Reinking 4187* (B), *4211* (B), Mount Maquiling, *C. F. Baker,* unnumbered specimen collected January, 1914 (B), *75* (B), *2613* (B), *2735* (B), *3388* (B), *3393* (B), *4461* (B), *W. H. Brown 16028, G. Cazeñas 2480* (B), on *Alphonsea arborea* (Blco.) Merr., *Alejandro de Mesa and Conicosa 50015, 50016,* on *Grevillea robusta, D. Diviñagracia 3415* (B), *P. W. Graff 16017, R. Habaluyas 9796* (B), *C. J. Humphrey 50014,* on *Parkia javanica* (Lam.) Merr., *50028,* on *Canarium ovatum* Merr., *50029,* on *Parashorea malaanonan* (Blanco) Merr., *50030, 50031,* on *Canarium ovatum* Merr., *50032,* on *Alphonsea arborea* (Blco.) Merr., *50040, V. Marilao 9621* (B), *S. Nantis 2518* (B), *E. Quisumbing 3634* (B), *O. A. Reinking 3614* (B), *4357* (B), *4364* (B), *4374* (B), *7383* (B), *9602* (B), *J. Reyes 9683* (B), *N. Reyes 3582, V. Serviñas 16930,* Santa Cruz, on *Cocos nucifera* L., *N. Reyes 2955* (B), on *Sandoricum koetjape* (Burm. f.) Merr., *N. Reyes 5110* (B); Nueva Vizcaya Province, Dupax, *R. C. McGregor 14376* (B. S.; B); Pampanga Province, Porac, *M. S. Clemens 4583,* Stotsenburg, *M. S. Clemens 2280;* Pangasinan Province, Umingan, *F. Otanes 18341;* Rizal Province, San Andales, *F. Rivera 50011;* Sorsogon Province, Irosin (Mount Bulusan), *A. D. E. Elmer 15944, 16080* (B. S.); Tarlac Province, on *Mangifera indica, M. S. Clemens 1596;* Tayabas Province, Alabat, *M. Ramos and G. Edaño 50005, 50009,* Calauag, on *Dipterocarpus grandiflorus, O. Ladia 50114,* Guinayañgan, *O. Ladia 50117, M. Oro 50111, 50113,* on *Dasymaschalon clusiforum, O. Ladia 50016, 50120,* on *Parashorea malaanonan, M. Oro 50115;* Quezon, *M. Ramos and G. Edaño 50006;* Zambales Province, Castillejos, *M. S. Clemens 3288,* Olongapo, *M. S. Clemens 4543, 4547, 4550.* MINDANAO, locality unknown, *Alejandro de Mesa 50033;* Cotabato Province, Cotabato, on *Cocos nucifera, C. J. Humphrey 50012, C. J. Humphrey 50038,* Kabacan, on *Hevea brasiliensis, C. J. Humphrey 50035,* Sarunayan, *C. J. Humphrey 50039;* Davao Province, Mate, *50013,* Mount Apo, *M. S. Clemens 50081;* Zamboanga Province, *H. S. Yates 35966, 35969, 35972,* on *Tarrietia javanica* Bl., *35962, 35979,* on *Chisocheton* sp., *36121,* on *Eucalyptus deglupta, 36130,* Lumarao, *Alejandro de Mesa 50082, 50083,* near Zamboanga, *C. J. Humphrey 12161* (H), on *Cocos nucifera, C. J. Humphrey*

50017, 50034. NEGROS, Occidental Negros, La Carlota Experiment Station, *J. M. Mendoza 50026;* Oriental Negros, Zamboanguita, *J. M. Mendoza 50025.* PALAWAN, *L. Escritor 21596* (B. S.; B.), Sir J. Brooke Point, vicinity of Imulnod, *Buenaventura Reyes 50022,* Kalbiga streams, *M. Ramos and G. Edaño 50004,* Mount Kabinbin, *Buenaventura Reyes 50021, 50023,* Mount Magkasaw, *Buenaventura Reyes 50024,* Puerto Princesa, *R. C. McGregor 47929,* Toba River, *M. Ramos and G. Edaño 50003.* PANAY, Antique Province, Culasi, *R. C. McGregor 32663;* Capiz Province, *G. Edaño 50007,* Libacao, *A. Martelino and G. Edaño 35832,* Mount Salibongbong, *A. Martelino and G. Edaño 35866.* POLILLO, Bulobalic, on *Diospyros* sp., *M. Oro 50012.* SAMAR, Loquilocon *M. S. Clemens 6091, 6092, 50002.*

GANODERMA APPLANATUM (Pers.) Pat. var. TORNATUM Pers. forma MACROSPORA Humph. f. nov.

When one examines a large series of *tornatum* specimens from the Orient a small proportion of them are found to have the same type of spores as *Ganoderma applanatum* var. *philippinense, Ganoderma mastoporum,* and some collections of *applanatum.* In other respects the plants (Plate 19, figs. 9 and 10; Plate 20; Plate 29, fig. 7) are inseparable from *tornatum.* It becomes necessary, therefore, to segregate these transitional forms for the convenience of other workers. The fact of spore differentiation here, reverting as it does to the base species, seems to the senior author added proof of the varietal relationship of *tornatum* to *applanatum.*

There are nineteen collections at hand, eight from the Philippines, two from the Federated Malay States (out of fifteen collections), and nine from Java (out of thirteen collections). The proportion from Java is, therefore, very high.

Of the Philippine material Lloyd was willing to call *Baker 4174* either *australe* or *applanatum,* but considered *Bu. Sci. 20389* (Plate 24, fig. 9) as *australe.* The Pahang specimen from the Federated Malay States (*8479*) he referred to *applanatum.* Only one of the Javan specimens (*1619*) was named and this Lloyd called *Fomes koningsbergii* Lloyd (Plate 20, figs. 9 and 10) with the note, "No. 88, Fomes koningsbergii, mss. now in printer's hands. It is very close to Fomes leucophaeus Mont. but has more minute pores and layers of resinous matter in its context."

With the exception of two stipitate specimens from Tjibodas, West Java [*5819* (Plate 20, figs. 7 and 8) and *6211* (Plate 20, figs. 5 and 6; Plate 36, fig. 6)], which are better referable here

than elsewhere in spite of their being atypical, the sporophores are applanate and sessile. All are sulcate in varying degree, a number of them lightly tuberculose.

The context shows the usual variation of *tornatum* in color and consistency, and is relatively thin. In all but one specimen (*Singapore 5722*) hard black streaks were present. The Singapore collection was provided with only fawn-colored ones, in this respect approaching variety *philippinense*.

The under surface usually varied around wood brown (R). In one specimen, however, it was light buff (R), and in another near purplish gray (R). Occasionally there were tinges of olive buff or honey yellow.

The pores (Plates 24, figs. 7 to 9; Plate 30, fig. 7; Plate 31, fig. 7) were circular to subangular, with thick, entire dissepiments. There is a tendency in some specimens toward the *mastoporum* type; that is, with somewhat elevated orifice (*Java, 5497, Bu. Sci. 2048*). For Philippine material they averaged 5.6 to the millimeter. Three Javan specimens were 5.3, 5.6, and 7, respectively, with an average of 5.9.

Four Philippine specimens were examined for ratio of pore-wall thickness to diameter of pores. The walls varied from 70 to 348 μ thick and the pores from 70 to 278 μ in diameter, the average ratios being 1 : 0.41, 1 : 0.46, 1 : 0.82, and 1 : 1.25, respectively. It is thus seen that the walls are usually very thick as compared with the diameter of the pores, in this respect corresponding to the harder-pored specimens of *tornatum*.

Mature spores (Plate 36, figs. 1 to 6) varied from deep olive buff to dark olive buff, younger ones being somewhat lighter, and were finely to rather coarsely striate, mostly the latter. The average for seventy-six measurements from the crushed mounts of six Philippine collections was 5.81 by 9.36 μ and for seventy measurements from the upper surface of seven collections 6.40 by 10.15 μ. Four Javan collections gave an average of 6.05 by 9.39 μ for fifty measurements from the crushed mounts, and three collections averaged 6.10 by 9.31 μ for twenty-seven measurements from the upper surface. One specimen from the Federated Malay States averaged 5.63 by 9.62 μ for ten measurements from the crushed mount, and the other gave 5.85 by 9.10 μ from the upper surface. As a rule these averages are slightly larger than for variety *philippinense* but are too close to use as a factor in distinguishing between individual collections.

SPECIMENS EXAMINED

FEDERATED MALAY STATES, Pahang, Fraser Hill, upon the Selangor border, *I. H. Burkill and R. E. Holttum 8479* (S), Tanah Rata, Cameron's Highland, *M. R. Henderson 17808A* (S); Singapore, Economic Gardens, *Kiah 5722* (S).

JAVA, Oengeran Mountains, *W. Docters van Leeuwen 1619* (Bg); West Java, Tjibodas, G. Gedeh, *Dr. Karny 2706* (Bg), *Bruggeman 5497, 5819, 6211* (Bg), *C. and D. van Overeem de Haas, Dakkus, Bruggeman and W. D. van Leeuwen 705* (*pro parte*) (Bg).

PHILIPPINE ISLANDS, LUZON, Camarines Sur Province, Mount Isarog, *G. Edaño 50089;* Laguna Province, Majayjay, *R. C. McGregor 50087, 50088,* Mount Banahao, *C. F. Baker 2945* (B), Mount Maquiling, *O. A. Reinking 4174* (B); Mountain Province, Ifugao Subprovince, Mount Polis, *20389* (B. S.; B). MINDANAO, Davao Province, Mount Apo, *M. S. Clemens 2048, 7637* (*pro parte*), *50066.*

SUMATRA, West Coast, Bukit Batu Banting, *E. Jacobson 5744* (Bg).

GANODERMA LOBATUM (Schw.) Atk.

This species was described by Schweinitz[164] from an abortive specimen collected at Salem, North Carolina, which is listed in his Synopsis Fungorum as *409–90.* This specimen was examined by the senior author at the Academy of Natural Sciences, Philadelphia, Pa. It is rather young but sufficiently characteristic to be matched quite readily with later collections.

According to Murrill[165] the fungus occurs as far north as New York. The senior author has found it throughout the states south of Illinois, Indiana, and Virginia and west to Arizona. It also occurs in Cuba.

The plant was well described from Ohio by A. P. Morgan as *Polyporus reniformis*[166] and passed under this name for many years in American mycological literature. Overholts[167] also gives a very good description of it under *Fomes lobatus.* Curtis[168] remarked that it has a strong odor of fresh farina.

[164] Trans. Am. Phil. Soc. II 4 (1832) 157.

[165] North American Flora 9, pt. 2 (1908) 114.

[166] Bot. Gaz. 7 (1882) 135.

[167] Polyporaceae of the Middle-western United States, Washington Univ. Studies 3, pt. 1 (1915) 63–64.

[168] Am. Journ. Sci. and Arts II 9 (1850) 174.

Cooke[169] thought it to be the same as *Ganoderma incrassata* (Berk.) but no one else has expressed this opinion.

The fungus occurs on stumps, dead stubs, fallen trunks and limbs, and occasionally at the base of living trees, apparently having a preference for oaks and maples. It seems to be a wound parasite at times, attacking the roots and base of the trunk.

It is quite distinct from *Ganoderma applanatum* in appearance, habit of growth, and spores, one of its striking characters being the revival of the old sporophores and the production of new ones below. The old ones soon become insect riddled and gradually disintegrate. This has led to the view that the plant is strictly annual, but there is often too close a consolidation of the old and new pore layers to accept this view without reservations. Where perennial, however, there is always a distinct rather thick layer of sterile tissue separating the old from the new growth.

The sporophores (Plate 21) are applanate to compressed ungulate, usually sessile, rarely stipitate. The largest specimen at hand is 6.5 inches long, about 11 inches wide, and 2.25 inches thick at the base and is much like the usual large forms of United States *applanatum* in shape. The next largest specimen is 4 inches long, about 6 inches wide, and nearly 2 inches thick at the base. The margin may be subacute, blunt, or broadly rounded.

The upper surface is usually broadly convex, slightly to strongly sulcate, and may be somewhat tuberculose. The crust (Plate 27, figs. 6 and 7; Plate 29, figs. 8 and 9) is usually *soft* and *thin*, and easily crushed with the thumb nail. In a number of the specimens it is much cracked, and sometimes flaked away. Young specimens are often velvety pubescent and warm buff (R) at the margin, becoming argus brown (R) to near Mars brown (R) behind. One is cinnamon (R) to tawny (R). Older specimens vary around russet (R), argus brown (R), Verona brown (R), or warm sepia (R). Some are distinctly banded with these shades or with blackish. One is grayish behind, as in many specimens of *applanatum*, while another is almost black.

In general the context is relatively thick, spongy to corky, firm or even hard in certain of the older specimens abundantly supplied with the hard black streaks (Plate 25, fig. 6). These

[169] Grevillea 14 (1885) 21; 15 (1886) 58.

streaks are present in varying degree, however, in all specimens. The context color usually ranges from russet (R) to chocolate (R) or bay (R), the darker colors being next to the pores. The russet shades may pale toward the crust or the growing margin, and sometimes a narrow zone of clay color (R) occurs just under the crust.

The under surface of some specimens varies between dark olive buff (R) and isabella color (R). These bruise to Verona brown (R). Other specimens vary from light drab (R) to wood brown (R).

Of the twelve collections available for study two are perennial, with two to three layers of pores separated by layers of sterile tissue 3 to 10 millimeters thick, the maximum length of the tubes being 2 centimeters. In longisection (Plate 27, figs. 6 and 7; Plate 31, figs. 8 and 9) the pores vary in color around benzo brown (R) and Natal brown (R).

The pore mouths (Plate 24, figs. 10 to 13; Plate 30, fig. 8) vary from circular to angular, with thin to medium dissepiments, which are entire or somewhat eroded. In size they range from 4.1 to 5.6 to a millimeter, the average for sixty measurements on ten collections being 5.0. Variation in the same specimen may be considerable, however, some pores being two to three times the diameter of the smaller ones.

Ten collections were examined for ratio of pore-wall thickness to diameter of opening. In one hundred measurements the walls varied from 42 to 306 μ and the openings from 167 to 445 μ, the average ratios for the ten being 1 : 1.42, 1 : 1.94, 1 : 1.97, 1 : 2.09, 1 : 2.29, 1 : 2.37, 1 : 2.53, 1 : 2.63, 1 : 2.75, and 1 : 2.86. It is thus seen that, on the average of ten measurements per specimen, the walls are in all cases thinner than the diameter of the pores.

The spores (Plate 36, figs. 7 to 12) are deep to dark olive buff or near old gold, with distinct, usually coarse, striæ. They average 6.33 by 9.66 μ for one hundred twenty measurements from the crushed mounts of ten collections and 6.63 by 10.11 μ for one hundred measurements from the upper surface of seven collections. There is sometimes considerable variability in the same specimen with respect to size. As will be seen from the photomicrograph of the spores of the type (Plate 36, fig. 7) some are comparatively small. Out of forty measurements from the upper surface of the Cuban specimen [*2853* (Plate 21, fig. 18)] only five spores were slightly larger than the average for the species, the remainder being appreciably smaller. The age

of the specimen apparently determines the average size, and to some extent the depth of color, but usually a few typical spores are present.

With respect to American species *lobatum* is easy to segregate. Nevertheless, certain specimens of *applanatum* from other parts of the world may have quite similar dark, coarsely striate spores, which would lead to confusion if spore characters alone were used.

SPECIMENS EXAMINED

CUBA, Ceballos, *C. J. Humphrey 2853.*

UNITED STATES, Alabama, Birmingham, Pratt Mine No. 8, *G. M. Hunt 7007,* Tuscaloosa, University campus, on *Quercus nigra, C. J. Humphrey 10583;* Arizona, Oracle, on stump of *Quercus emoryi, G. G. Hedgcock and W. H. Long 2364;* Florida, Miami, Brickell's Hammock, *C. J. Humphrey 6983,* near Orlando, on seedling orange, *J. R. Winston 5027;* Georgia, Vienna, on *Acer rubrum, C. J. Humphrey 2375;* Illinois, Du Quoin, on *Quercus* sp., *C. J. Humphrey 1343,* Metropolis, at base of large living *Morus* sp., *C. J. Humphrey 9661,* on *Quercus* sp., *C. J. Humphrey 9670;* Indiana, Greenwood, *M. C. Jensen 1202, 6884;* Louisiana, near Baton Rouge, *C. J. Humphrey and C. W. Edgerton 5591,* at base of living *Acer rubrum, C. J. Humphrey and C. W. Edgerton 5702,* St. Martinsville, *C. J. Humphrey 4391;* Mississippi, Laurel, on *Quercus* sp., *C. J. Humphrey 5420;* North Carolina, *W. C. Coker 8229,* Salem, *ex herb. Schweinitz 409–90 (type);* Texas, Texarkana, *C. J. Humphrey 13070;* Virginia, near Washington, D. C., *W. A. Murrill, ex herb. N. Y. Bot. Gard.*

All the specimens cited are in herb. Humphrey.

MICROSCOPIC FEATURES AS DIFFERENTIAL CHARACTERS

The following synoptic tables (Tables 1 and 2) give the principal microscopical characters of the species and varieties recorded.

In interpreting Table 1 it should be kept in mind that data on the pores and dissepiments are based on a comparatively few specimens selected to show variation, and hence cannot give a true average of the more usual condition. In making the measurements, however, a dissepiment was always paired with the adjoining pore.

It should be noted that the measurements of wall thickness and diameter of pores cannot be correlated with the number of pores per millimeter, for the reason that the former were

TABLE 1.—*Measurements of Pores.*

Species or variety.	Region.	Specimens examined.		Pores.												
				Average number per mm.	Wall thickness range.	Diameter range.	Average ratio thickness to diameter.									
		For pores.	For ratio.				0 : 0.50	0.51 : 1.00	1.01 : 1.50	1.51 : 2.00	2.01 : 2.50	2.51 : 3.00	3.01 : 3.50	3.51 : 4.00	4.01 : 4.50	4.51 : 5.00	5.01 : 6.00
Ganoderma applanatum	United States and Canada	16	6	5.3	42–417	139–486	----	1	----	1	1	3	----	----	----	----	----
Do	Austria	1	1	4.7	28–167	208–445	----	----	----	----	----	----	----	1	----	----	----
Do	England	2	2	4.5	56–306	167–459	----	1	----	----	----	1	----	----	----	----	----
Do	Russia	1	1	4.8	28–83	70–167	----	----	----	----	1	----	----	----	----	----	----
Do	Uruguay	1	1	5.0	111–167	70–125	----	1	----	----	----	----	----	----	----	----	----
Do	Japan	9	3	4.8	70–417	111–417	----	----	2	----	----	----	1	----	----	----	----
Do	China	3	2	4.7	56–139	111–167	----	----	1	1	----	----	----	----	----	----	----
Do	Formosa	4	3	4.8	56–250	167–486	----	----	----	1	2	----	----	----	----	----	----
Do	Australia	6	6	4.8	56–278	83–278	----	1	4	----	1	----	----	----	----	----	----
Do	New Zealand	1	1	4.2	42–139	83–139	----	----	1	----	----	----	----	----	----	----	----
Do	Brazil	5	5	5.2	70–375	111–306	----	3	1	1	----	----	----	----	----	----	----
Do	Uganda	1	1	4.2	28–56	139–236	----	----	----	----	----	----	----	----	----	----	1
Do	Ceylon	1	1	4.8	28–70	111–208	----	----	----	----	----	----	1	----	----	----	----
Do	Dutch East Indies	2	2	4.5	28–111	97–208	----	----	----	----	----	1	1	----	----	----	----
Do	Philippines	7	7	5.2	14–167	70–208	----	----	2	3	1	----	----	----	----	1	----
G. a. var. *brownii*	United States (California)	7	7	4.3	70–417	139–417	----	2	4	----	1	----	----	----	----	----	----
G. a. var. *laevisporum*	Philippines; one from Java	5	7	5.5	7–70	83–208	----	----	----	----	----	2	2	2	----	----	1
G. a. var. *philippinense*	Philippines	21	13	5.4	42–348	83–348	1	6	4	2	----	----	----	----	----	----	----
G. a. var. *tornatum*	Philippines; one from Africa	20	14	5.7	28–348	83–348	1	2	3	2	2	1	----	----	1	2	----
Do	Dutch East Indies	3	3	5.6	42–167	56–139	----	2	----	----	1	----	----	----	----	----	----
Do	Federated Malay States	5	5	5.8	42–195	56–153	----	1	3	----	1	----	----	----	----	----	----
Do	Australia	1	1	5.1	70–153	83–167	----	----	1	----	----	----	----	----	----	----	----
forma *macrospora*	Philippines	3	4	5.6	70–348	70–278	2	1	1	----	----	----	----	----	----	----	----
Do	Dutch East Indies	3	3	5.9	56–195	42–167	1	----	----	2	----	----	----	----	----	----	----
Do	Federated Malay States	2	2	5.2	56–167	56–111	----	2	----	----	----	----	----	----	----	----	----
Ganoderma lobatum	United States; one from Cuba	10	10	5.0	42–306	167–445	----	----	1	2	3	4	----	----	----	----	----

selected here and there to get extremes of variation, while the latter represent more nearly an average for the sporophore.

In *applanatum* the average number per millimeter ranges from 4.2 for a single New Zealand and a single Uganda specimen to 5.3 for United States material, but the remainder fall between 4.5 and 5.2. The range for the United States, however, is 4.5 to 6.7; for Europe 4.5 to 4.8; for Japan 4.0 to 5.7; for China 4.2 to 5.0; for Formosa 4.4 to 5.2; for Australia 4.1 to 5.0; for Brazil 4.8 to 5.8; for the Dutch East Indies 4.2 to 4.8; and for the Philippines 4.5 to 5.8. It is thus seen that the individual ranges overlap to such an extent that pore size is of no value in separating specimens from different countries.

In variety *brownii* the range is from 3.9 to 4.7, which is somewhat under the range for the species.

In variety *laevisporum* the range is from 4.8 to 5.8, with an average somewhat higher than for the species.

Variety *philippinense* also averages somewhat higher than the species, ranging between 4.9 and 6.1, which is within that for United States specimens.

In variety *tornatum,* with the exception of the specimen from Australia, the range also falls within that for United States material of *applanatum,* 4.9 to 6.4, but the average is considerably higher, being 5.7 for the Philippines, 5.6 for the Dutch East Indies, and 5.8 for the Federated Malay States.

In *Ganoderma lobatum* the range is from 4.1 to 5.6 and is, therefore, quite close to *applanatum.*

As far as wall thickness is concerned one may find thin-walled and thick-walled pores in both *applanatum* and its varieties, depending largely on the age of the specimens.

In *applanatum* the average range (averaged from ten selected measurements per specimen) for the United States is from 84 to 241 μ; for Europe 56 to 229 μ; for Japan 101 to 272 μ; for China 84 to 97 μ; for Formosa 129 to 153 μ; for Australia 71 to 196 μ; for Brazil 117 to 267 μ; for the Dutch East Indies 48 to 59 μ; and for the Philippines 34 to 88 μ.

In variety *brownii* the corresponding figures are 168 to 260 μ; it is, therefore, a comparatively thick-walled form.

In variety *laevisporum* they are 25 to 48 μ, this being a very thin-walled form.

Variety *philippinense* runs from 129 to 257 μ.

In variety *tornatum* from the Philippines the average ranges are 56 to 258 μ; from the Dutch East Indies 53 to 132 μ; from the Federated Malay States 57 to 143 μ.

In *Ganoderma lobatum* they are 102 to 182 μ.

The only conclusion that the writer can draw is that wall thickness as a specific or varietal character is of no value unless coupled with other characters. The current conception of *tornatum* is that of a thick-walled form, and it is quite true that many of the specimens are so, but one can find just as thick-walled ones in *applanatum* from Brazil and Japan, and even from the United States.

Variation in the diameter of the pores is just as great as in the thickness of the dissepiments. For the United States the average ranges for *applanatum* are 174 to 410 μ (only one at the upper limit, the next highest being 254 μ); for Europe 132 to 388 μ; for Japan 256 to 338 μ; for China 140 to 142 μ; for Formosa 285 to 313 μ; for Australia 100 to 211 μ; for Brazil 173 to 225 μ; for the Dutch East Indies 153 μ; and for the Philippines 101 to 161 μ.

In variety *brownii* the average ranges are 211 to 353 μ.

In variety *laevisporum* they are 125 to 164 μ.

Variety *philippinense* ranges from 129 to 266 μ.

In variety *tornatum* from the Philippines they are 97 to 268 μ; from the Dutch East Indies 69 to 108 μ; from the Federated Malay States 81 to 122 μ.

Ganoderma lobatum pores run from 259 to 355 μ.

In an attempt to interpret the above data on wall thickness and diameter of pores the average was computed for measurements on all the specimens within the regional group. It was found, however, that such data cannot safely be used. As an example, *tornatum* from the Philippines has 5.7 pores per millimeter, based on one hundred twenty measurements from twenty representative specimens. The average for wall thickness was 129 μ and for diameter of pores 210 μ. This would be interpreted as moderately large pores and medium dissepiments, whereas the tendency is toward small pores and rather thick dissepiments. Furthermore, if one should attempt to use the average of the actual measurements on walls and pores and compute on the basis of 5.7 pores to the millimeter the walls alone would occupy 645 μ, leaving only 355 μ for the pores which actually compute 1,080 μ. The total for walls and pores then would be 1,725 μ, an overrun of 72.5 per cent. For Japanese *applanatum* the overrun would be 116 per cent.

In computing the ratio of wall thickness to diameter of pores the total of ten measurements on walls was divided into the

TABLE 2.—*Measurements of hyphæ and spores (μ).*

Species or variety.	Region.	Hyphæ.				Spores.	
		Context.		Dissepiments.		Crushed mount.	
		Range.	Average.	Range.	Average.	Average.	Ratio width to length.
Ganoderma applanatum	United States and Canada	1.8– 9.8	4.5	1.8–6.3	3.9	5.41× 8.15	1.51
Do	Austria	2.2– 7.5	4.5	2.2–6.7	4.5	5.2 × 7.8	1.50
Do	England	2.2– 6.7	4.3	2.2–6.7	3.9	6.1 × 9.6	1.57
Do	Russia	2.3– 7.2	4.2	2.3–6.0	4.0	6.2 × 9.2	1.48
Do	Uruguay	3.0– 6.8	4.9	2.7–5.7	3.8	6.5 ×10.7	1.65
Do	Japan	1.8– 8.2	4.3	2.2–6.0	3.9	5.45× 8.35	1.53
Do	China	2.2– 7.5	4.2	2.2–5.7	3.9	5.5 × 8.3	1.51
Do	Formosa	2.3– 6.8	4.0	2.3–6.0	3.9	6.46× 9.56	1.48
Do	Australia	1.8– 7.2	4.1	1.8–6.0	3.4	6.69×10.78	1.61
Do	New Zealand	2.3– 9.0	4.7	2.3–4.5	3.2	6.7 ×10.4	1.55
Do	Brazil	2.2–10.4	4.4	2.2–6.3	3.6	6.08× 9.72	1.60
Do	Uganda	2.7– 7.5	4.4	2.3–6.0	3.9	6.4 × 8.5	1.33
Do	Ceylon	2.3– 6.3	4.4	1.8–5.3	3.6	6.3 × 9.6	1.52
Do	Dutch East Indies	1.8– 7.5	4.0	2.3–6.8	3.8	6.1 × 8.3	1.36
Do	Philippines	1.8– 9.0	4.3	1.8–8.2	4.1	5.29× 8.35	1.58
G. a. var. *brownii*	United States (California)	2.2– 9.7	5.0	1.5–7.5	3.8	7.60×11.62	1.53
G. a. var. *laevisporum*	Philippines; one from Java	2.2–10.5	4.5	1.5–8.2	3.6	4.97× 8.62	1.73
G. a. var. *philippinense*	Philippines	1.2–12.0	4.5	1.5–8.3	3.6	5.43× 8.77	1.62
G. a. var. *tornatum*	Philippines; one from Africa	1.8–10.4	4.5	1.5–9.0	4.1	5.03× 7.58	1.51
Do	Dutch East Indies	2.3– 8.3	4.1	1.8–6.0	3.6	5.16× 7.62	1.48
Do	Federated Malay States	2.3– 8.3	4.2	1.5–7.5	3.7	5.97× 7.83	1.31
Do	Australia	1.8– 6.8	4.2	1.8–6.0	3.5	6.0 × 8.3	1.31
forma *macrospora*	Philippines	1.8–10.5	4.6	1.8–7.5	4.0	5.81× 9.36	1.61
Do	Dutch East Indies	1.8– 7.5	4.0	1.8–6.3	3.6	6.05× 9.39	1.55
Do	Federated Malay States	2.3– 6.8	4.2	2.3–6.0	3.9	5.63× 9.62	1.71
Ganoderma lobatum	United States; one from Cuba	2.2–10.5	4.7	1.5–9.0	4.1	6.33× 9.66	1.53

Species or variety.	Region.	Spores.					
		Crushed mount.		Upper surface.			
		Range.		Average.	Ratio width to length.	Range.	
		Length.	Width.			Length.	Width.
Ganoderma applanatum	United States and Canada	6.3–10.8	4.5–7.5	6.35× 9.15	1.44	7.8–10.5	5.3–7.5
Do	Austria	6.7– 9.0	4.5–6.0				
Do	England	8.2–11.2	4.5–7.5				
Do	Russia	8.3–10.2	5.7–6.8				
Do	Uruguay	9.8–11.7	6.0–7.5				
Do	Japan	6.0–10.4	4.5–6.7	6.3 × 9.5	1.51	8.7–10.2	5.7–6.8
Do	China	7.5– 9.0	4.8–6.0				
Do	Formosa	8.7–10.5	5.7–7.8	6.30× 9.35	1.48	9.0– 9.8	6.0–6.8
Do	Australia	9.0–12.0	4.8–7.8	6.98×11.07	1.59	8.7–12.3	5.7–7.8
Do	New Zealand	9.8–10.8	6.0–7.2	6.9 ×10.7	1.55	9.8–11.3	6.0–7.2
Do	Brazil	7.5–11.9	4.5–7.5	6.89×10.38	1.51	7.5–12.0	6.0–8.3
Do	Uganda	7.5– 9.0	5.7–7.5	6.1 × 8.9	1.46	6.8–11.3	5.3–7.2
Do	Ceylon	9.3–10.5	6.0–6.8				
Do	Dutch East Indies	7.5– 9.0	5.7–6.3				
Do	Philippines	6.0–11.2	4.2–6.7	6.4 ×10.2	1.59	9.0–12.0	5.7–7.2
G. a. var. *brownii*	United States (California)	9.7–13.5	6.0–10.5	7.92×12.46	1.57	11.3–13.5	7.5–8.3
G. a. var. *laevisporum*	Philippines; one from Java	6.7–10.4	4.5–5.7	5.69× 8.92	1.55	8.3–10.2	5.3–6.3
G. a. var. *philippinense*	Philippines	7.5–10.4	4.5–7.5	6.16× 9.45	1.53	9.0–11.3	6.0–7.5
G. a. var. *tornatum*	Philippines; one from Africa	6.0–10.5	4.2–6.7	5.44× 7.83	1.44	6.7–10.5	4.8–6.3
Do	Dutch East Indies	6.3– 8.7	4.8–6.0	5.63× 7.93	1.41	7.5– 8.7	4.8–6.3
Do	Federated Malay States	6.8– 9.0	4.5–6.8	5.79× 8.63	1.49	7.8– 9.3	5.3–6.3
Do	Australia	7.5– 9.0	5.7–6.3	6.25× 8.68	1.39	7.8– 9.8	5.7–6.8
forma *macrospora*	Philippines	9.0–11.3	4.8–6.8	6.40×10.15	1.59	9.3–11.7	5.7–7.5
Do	Dutch East Indies	9.0–10.5	5.7–6.8	6.10× 9.31	1.53	9.0– 9.8	5.7–6.3
Do	Federated Malay States	9.0–10.2	5.3–6.3	5.85× 9.10	1.56	9.0– 9.3	5.7–6.0
Ganoderma lobatum	United States; one from Cuba	8.2–11.9	5.2–9.0	6.63×10.11	1.52	11.3–13.2	6.3–8.7

total of ten measurements on pores. The individual averages are tabulated to show distribution.

The ratios indicate that for *applanatum* the majority of the collections have pores equal to or up to two and one-half times the thickness of the dissepiments; in variety *brownii* the ratios tend to be somewhat lower, in this respect agreeing with varieties *philippinense* and *tornatum*. *Ganoderma lobatum*, on the other hand, falls more in the category of United States *applanatum*.

Data on the hyphæ and spores include measurements on all the specimens, hence are quite representative of the material reported in the paper and furnish a good average for the larger groups. Unfortunately, however, not enough specimens were available from many of the countries to furnish data sufficient for more than tentative comparisons.

Hyphæ.—Hyphal measurements are of no value as diagnostic characters, averaging throughout the series between 4 and 5 μ for the context and between 3.2 and 4.5 μ for the dissepiments. The larger average for the context hyphæ is due to the inclusion in the context of a few hyphæ of larger dimension than any in the dissepiments.

Spores.—As a rule, the spores taken from the upper surface are larger and darker than those from the context. Also, being frequently more mature, the striæ may be coarser. While we have endeavored to include only apparently mature spores among those measured from the crushed mounts, still the fact that they average smaller than ones from the upper surface indicates that in many instances they have not attained full development. The upper limits are essentially the same, however, whether taken from crushed mount or the upper surface.

Ganoderma applanatum spores run between 9 and 11 μ in length and between 6.8 and 8.3 μ in width.

Variety *brownii* has the largest spores of the group, the upper limits being 13.5 μ for length and 8.3 μ for width.

Variety *philippinense* has spores that are too close to *applanatum* for more than general use as a varietal character, although they have a strong tendency to be paler in color, less coarsely striate and somewhat narrower.

Variety *tornatum*, on the other hand, has very distinctive spores that offer a very good character for varietal segregation. Their upper limits are, as a rule, appreciably under those for *applanatum*. They run usually 7.5 to 8.5 μ long and 4.5 to 5.5 μ

wide, tend to the elliptical, very often lack the truncate or pointed end, and are usually dark and coarsely striate. Forma *macrospora,* however, has the same spores as variety *philippinense,* although averaging slightly larger.

Ganoderma lobatum has spores that occasionally run as large as *brownii,* although the average size is considerably smaller. They are appreciably larger than in *applanatum* from the United States, but are often equaled or surpassed in specimens from other countries, particularly Australia, New Zealand, and Brazil.

Crust.—Photomicrographs of sections through the crust show that the hyphæ take on more or less of a vertical arrangement, small pale ones being intermixed with thicker-walled dark brown ones. Some become clavate at the tips, but no definitely organized palisade layer, resembling basidia, is developed, such as is uniformly found in species of true *Ganoderma.* This is another argument in favor of the segregation of the *Fomes* type of *Ganoderma* into a separate section.

In no instance has there been found any evidence that the club-shaped hyphal endings are conidia-bearing. The spores that accumulate on the upper surface of the sporophores are deposited there by air currents and are purely accidental. Only one representative specimen of each species or variety was sectioned for the crust; therefore, it cannot be stated what differences may exist between young and mature specimens, or what variations may occur in different specimens of the same degree of maturity. The illustrations are introduced largely to show the general structure. We do not believe that such characters can consistently be used in specific or varietal segregation.

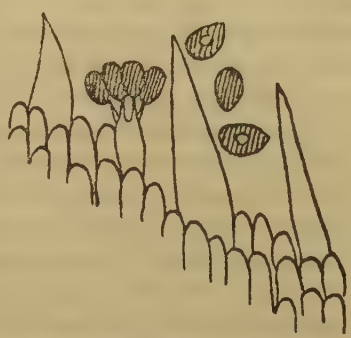

FIG. 1. Hymenium of *Ganoderma applanatum* showing cystidia and spores (after Demelius, pl. 2, fig. 8; enlarged 1.5).

Cystida.—Although Patouillard [170] mentions the occasional presence of cystidia in *Ganoderma* and Demelius [171] reports them as frequent in *Ganoderma applanatum* and gives a good illus-

[170] Bull. Soc. Myc. Fr. 5 (1889) 65.

[171] Beiträge zur Kenntnis der Cystiden, V, *in* Verh. k. k. Zool. bot. ges. Wien. 62 (1912) 117.

tration, the writers have not observed them in the comparatively few dry specimens sectioned, for the hymenium was very much disorganized in all. Demelius' figure shows them as sharp-pointed, colorless, thin-walled, fusiform bodies projecting well beyond the basidia. It is herewith reproduced as a matter of record.

SUMMARY AND CONCLUSIONS

The study was carried out in an effort to throw further light on the relationship of the many variations of *Ganoderma applanatum* and closely related species that occur throughout the world, and are particularly prevalent in the Tropics. It is not a monographic treatment, since a number of the species described within the group were not available for examination. It is believed, however, that the system of classification adopted will cover nearly all the temperate-zone variants and that at least 90 per cent of the collections of tropical forms will readily fall within it.

An effort has been made to discuss, to some extent at least, all the described species that pertain to the group. Many of these are obviously nothing but forms and can be dropped from the list of valid species, while others show so many intergrading characters that they are better classed as varieties.

The results presented are based on gross comparisons and critical microscopic examination, particularly of spores and hyphæ, of approximately 380 collections from various parts of the world, but more particularly from the Philippines. These specimens include all the material in the Bureau of Science herbarium at Manila, the Baker herbarium at Los Baños, and the herbaria at the Buitenzorg and the Singapore Botanical Gardens, besides a considerable amount of material in the herbarium of the senior author.

In the segregation of variants within the group only two species and four well-marked varieties are recognized; namely, *Ganoderma lobatum* (Schw.) Atk. and *Ganoderma applanatum* (Pers.) Pat., with its varieties *brownii* Murr., *laevisporum* Humph. var. nov., *philippinense* Humph. var. nov., and *tornatum* Pers. The new form *macrospora* Humph. is also erected as an adjunct of *tornatum*. A few other varieties or species have been omitted until authentic material can be examined.

Both gross and microscopic features have been used as characters upon which to base these variants.

Ganoderma applanatum is the common temperate-zone form occurring throughout Europe and the United States, temperate

South America and Africa, temperate Australia, China, Japan, Formosa, and occasionally at the higher altitudes in the Tropics. It shows a rather wide range of variation both in general appearance and spore characters. In the case of forms with thin context the larger spores can be used as a differentiating character to set it off from variety *tornatum*. In the Tropics young forms with rather small spores are occasionally difficult to interpret.

Variety *brownii* results from a reduction of *Elfvingia brownii* Murr. to varietal rank. It is principally based on the large spores, the largest in the group, although the plant tends more to the ungulate than is usual in the base species. Certain forms of *applanatum* from temperate Australia approach the variety quite closely in spore characters but less so in general appearance; in fact, most of the *applanatum* specimens examined from Australia have somewhat larger spores than is usual for the species.

Variety *laevisporum* has been set off largely on account of the wholly nonstriate spores, although the pores are rather small and thin-walled and there are other minor things that serve as "ear marks" rather than as invariable key characters. It has only been reported from the higher altitudes of the Philippines, and once from Java, where it is less typical. It should be remarked, however, that in Japan there are occasional variants of *applanatum* with nonstriate spores; in gross characters some of them are indistinguishable from the base species while others are sufficiently distinct to constitute a separate variety. These need further study from additional collections.

The only other form with nonstriate spores is one having the general appearance of *annulare* Lloyd. Opinion on this is withheld until his type can be studied.

Variety *philippinense* is established principally on gross characters. The upper surface is characteristically tuberculose, there are frequently fawn-colored streaks or bleached areas in the context, and in many specimens the pore surface becomes darkened to mouse gray or blackish slate. It seems to be an analogue of the broadly applanate forms of the base species occurring in the United States, with sufficient variations to set it off as a distinct variety. Bresadola referred many of the specimens to *Ganoderma subtornatum* Murr., while Patouillard frequently used the name *leucophaeum* Mont.

Variety *tornatum* is very distinct in its fully developed and typical condition, and the smaller coarsely striate spores serve

to set it off clearly in most instances. There is, however, a form of it (forma *macrospora* Humph.) which has spores indistinguishable from *applanatum* but sporophores of the same general appearance as *tornatum*. This intermediate form links the base species (*applanatum*) with the variety. Additional evidence of the close relationship exists in the hard, rather small, applanate forms of *applanatum* with moderately thin context that occur in Japan, and occasionally elsewhere.

The name *tornatum* has been selected on account of priority and the existence of the type at Paris. *Ganoderma australe* of Fries is in much dispute. The writer is advised by Miss E. M. Wakefield, of Kew, that the only known Friesian specimen of this species that exists is believed to be at Kew, but it is insect eaten and has lost its outer crust, hence nothing can be established as to the original character of either crust or context. The spores, however, she states, are distinctly larger than in English material. This would preclude the application of the name to the writer's concept of the variety. The presence of rather large spores, however, does not necessarily remove it from *applanatum*, for Australian specimens are predominantly large spored, as is also the single Uruguayan specimen reported. Likewise a comparison of figs. 4 and 5, of Plate 31, will show a wide variation in size of spores from a single English specimen, the larger being quite comparable in size to those of variety *brownii*.

Typical well-developed specimens of *tornatum* are usually applanate, comparatively thin, rather heavy, with comparatively small, thick-walled pores, and a thin context, but many of the smaller specimens are of light weight, with a soft crust and thin-walled larger pores. They even tend to stipitate. These aberrant or young forms have led to much confusion in classification, but they are indubitably connected with the variety by insensible gradations, as shown by forms growing together on the same log.

Ganoderma lobatum is maintained as a distinct species. As compared with United States material it has spores intermediate between *applanatum* and variety *brownii*. The crust is usually soft, thin, and considerably cracked and there is always a distinct rather thick layer of sterile tissue separating the old from the new growth. This has led to the idea that the plant is annual. There is, however, only a gradual dying of the older growth, the newer layers of pores often arising from the old as they do in the "*vegetus*" form of *applanatum*. The general

effect of old perennial sporophores is that the top layers are dead and often insect-eaten with the crust flaked away. This would be very unusual for any other member of the group.

Pore sizes, wall thickness, and size of spores and hyphæ are presented in Tables 1 and 2 so that direct comparison of the averages can be made.

As to number of pores per millimeter the individual ranges overlap to such an extent that they are of no value in separating specimens of *applanatum* from different countries, although *brownii* runs somewhat under the average for the species and *laevisporum* and *philippinense* average somewhat over. The average for *tornatum* is considerably higher.

Pore-wall thickness as a specific or varietal character is of no value unless coupled with other characters. Neither can the ratio of pore-wall thickness to diameter of opening be used safely as a differential character.

Spores offer reasonably good distinguishing characters in varieties *brownii, laevisporum,* and *tornatum.* In *Ganoderma lobatum* they are safe enough in comparison with North American material, but unfortunately would cause confusion if used in separating large-spored specimens of *applanatum* from other parts of the world.

Hyphal measurements are of no value within the group.

Sections of the crust show that the hyphæ take on a more or less vertical arrangement, small pale hyphæ being intermixed with thicker-walled dark brown ones. Some become clavate at the tips, but no definitely organized palisade layer, resembling basidia, is developed, such as one uniformly finds in species of true *Ganoderma.* No evidence has been found that the crust is conidia-bearing.

The comparatively few specimens sectioned showed no cystidia, such as were figured by Demelius, but this is probably due to the disorganization of the hymenium.

The study leads to the general conclusion that *Ganoderma applanatum* and its near relatives form an intergrading aggregate which is difficult to split on any invariable character or characters. The best that can be done is to set off certain of the larger groups as varieties with an "ensemble" of group characters; retaining only *applanatum* and *lobatum* as species. *Tornatum* is apparently the strongest variety and might be worthy of subspecific rank if the senior author believed in subspecies.

ILLUSTRATIONS

PLATE 1

GANODERMA APPLANATUM (PERS.) PAT. UNITED STATES

FIG. 1. Section of *2348* (H), Washington. This type of sporophore with bleached context and pores is very common on *Tsuga heterophylla* in the Pacific northwest; × 0.30.

2. Upper surface of specimen designated "C" in herb. Humphrey, Wisconsin. This is a very common form and represents *G. leucophaeum* of Montagne; × 0.29.

3. Section of "C" shown in fig. 2; × 0.29.

4. Upper surface of a stipitate specimen designated "B" in herb. Humphrey, Wisconsin; × 0.25.

5. Section of "B" shown in fig. 4; × 0.25.

6. Section of a form with thin context, *1369* (H), Illinois; × 0.32.

7. Under surface of a specimen from Wisconsin showing the facility with which it can be etched.

8. Upper surface of *2344* (H), Iowa; × 0.32.

9. Section of *2344* shown in fig. 8. Note the concentric color zones; × 0.32.

10. Large specimen growing on a hard maple log in the forests of the upper peninsula of Michigan.

11. A small atypical pileate specimen taken from mine props of *Acer saccharum* at Ironwood, Michigan.

12. One of the many digitate forms which the fungus assumes when growing in the dark. This plant is about 15 inches long and came from a hard maple mine prop at Ironwood, Michigan. It was associated with the pileate form shown in fig. 11.

13. Section of an unusual-shaped sporophore having a very thin context such as is common in variety *tornatum*. Specimen from the New York State College of Agriculture, Syracuse, in herb. Baker; × 0.33.

14. Section of an English specimen from the Kew Herbarium, at the Bureau of Science; × 0.32.

15. Upper surface of *11537* (H), Japan. This form has nonstriate spores and will probably prove worthy of varietal distinction after a thorough study of Japanese forms has been made; × 0.36.

16. Section of *11537* (H) shown in fig. 15; × 0.32.

PLATE 2

GANODERMA APPLANATUM (PERS.) PAT.

FIG. 1. Section of *782* (B. S.), from the Botanical Museum, Montevideo, Uruguay. Typical of the temperate zone; × 0.36.

2. Upper surface of *11617* (H), Japan. The upper surface is silvery and the context pale; × 0.45.

FIG. 3. Section of *11617* shown in fig. 2; × 0.45.
4. Section of *12583* (H), Japan. Compare with Brazilian specimen shown in Plate 4, fig. 5; × 0.45.
5. Upper surface of *11623* (H), Hongkong, China. This specimen matches certain of those from the Philippines; × 0.45.
6. Section of *11623* shown in fig. 5; × 0.45.
7. Upper surface of *12589* (H), Japan; × 0.45.
8. Section of *12589* shown in fig. 7; × 0.45.
9. Upper surface of *Hemmi 25* (H), Japan; × 0.45.
10. Upper surface of *12587* (H), Japan; × 0.41.
11. Section of *12587* shown in fig. 10; × 0.47.
12. Upper surface of two specimens, *Sawada 68* (H), Formosa; × 0.43.
13. Upper surface of *Sawada 78* (H), Formosa; × 0.44.

PLATE 3

GANODERMA APPLANATUM (PERS.) PAT.

FIG. 1. Upper surface of *Cleland 1* (H), South Australia. This form approaches variety *brownii;* × 0.37.
2. Section of *Cleland 1* shown in fig. 1; × 0.35.
3. Upper surface of *Cleland 13* (H), South Australia; × 0.45.
4. Section of *Cleland 13* shown in fig. 3; × 0.41.
5. Upper surface of *Cleland 14* (H), Tasmania; × 0.33.
6. Section of *Cleland 14* shown in fig. 5. This specimen is referable to the base species on its general appearance and spores although it has in the context the fawn-colored streaks of variety *philippinense;* × 0.33.
7. Section of *Cleland 9* (H), Flinders Island, Australia; × 0.38.
8. Upper surface of *Cleland 8* (H), New South Wales, Australia. From the illustration this would be taken for variety *tornatum* on account of its thin context. The spores, however, are those of the base species; × 0.33.
9. Section of *Cleland 8* shown in fig. 8; × 0.41.
10. Upper surface of *Cleland 27* (H), New South Wales. This specimen is very similar to the Brazilian one shown in Plate 4, fig. 4; × 0.33.
11. Section of *Cleland 27* shown in fig. 10; × 0.33.

PLATE 4

GANODERMA APPLANATUM (PERS.) PAT.

FIG. 1. Upper surface of a short stipitate specimen of *11059* (H), Brazil. Not included in the present paper and probably represents *testaceum* Lév. Added to the illustrations for the purpose of comparison; × 0.49.
2. Small thick specimen of *11059*, which has a very thin context and was attached at the vertex; × 0.49.
3. A small thin specimen of *11059*, which was broadly attached by the upper surface as if growing on the underside of a log; × 0.49.
4. Section of *10754* (H), Brazil; × 0.49.

FIG. 5. Section of *11058* (H), Brazil. This is a rather hard specimen quite comparable to forms occurring in Japan; × 0.50.
6. Upper surface of an unusual specimen, *11054* (H), Brazil. It is somewhat intermediate between *applanatum* and *lobatum* and would be referred to the latter were the spores typical of that species; × 0.47.
7. Section of *11054* shown in fig. 6. The context is corky; × 0.49.
8. Upper surface of *11056* (H), Brazil. Probably referable to *testaceum* Lév. and not recorded in the present paper; × 0.49.
9. Section of another specimen of *11056* which was attached at the vertex; × 0.49.
10. Section of *11055* (H), Brazil; × 0.39.
11. Upper surface of *4960*, herb. Peradeniya, from Ceylon; × 0.44.
12. Section of *4960* shown in fig. 11; × 0.42.
13. Upper surface of a specimen from herb. Peradeniya, Ceylon, sent as *Fomes annularis* Lloyd, "a stratose form of *Fomes applanatus* Pers;" × 0.54.
14. Section of the specimen shown in fig. 13; × 0.50.

PLATE 5

GANODERMA APPLANATUM (PERS.) PAT.

FIG. 1. Upper surface of *2654* (Bg), Sumatra; × 0.33.
2. Section of *2654* shown in fig. 1; × 0.30.
3. Upper surface of *6315* (B. S.), Mountain Province, Luzon, P. I. Specimen whitish above; × 0.31.
4. Section of *6315* shown in fig. 3; × 0.31.
5. Section of *50100* (B. S.), Mountain Province, Luzon, P. I.; × 0.32.
6. Section of large irregular specimen, *16195* (B. S.), Luzon, P. I.; × 0.33.
7. Upper surface of an old blackened specimen, *3289* (B. S.), Luzon, P. I.; × 0.28.
8. A younger light brownish specimen of *3289*. Rather atypical but better referable to the base species than elsewhere; × 0.32.
9. Section of *3289* shown in fig. 8; × 0.32.
10. Upper surface of a very unusual specimen which has the spores of the base species, *50099* (B. S.), Mount Isarog, Luzon, P. I.; × 0.29.
11. Lower surface of *50099* shown in fig. 10; × 0.33.
12. Section of *50099* shown in figs. 10 and 11. The pores are severely bleached; × 0.35.
13. Section of *50102* (B. S.), Mount Banahao, Luzon, P. I. Note the bleaching of the pores and context; × 0.36.
14. Section of a young sterile specimen of *50102* with the context nearly wholly bleached; × 0.32.
15. Upper surface of *45860* (B. S.), Luzon, P. I.; × 0.31.
16. Section of *45860* shown in fig. 15; × 0.31.
17. Upper surface of specimen from West Java, *1926* (Bg). Determined by Patouillard as *Ganoderma fasciatum* (Lév.); × 0.32.
18. Section of *1926* shown in fig. 17; × 0.32.

Plate 6

GANODERMA APPLANATUM (PERS.) PAT. VAR. BROWNII MURR.

FIG. 1. Side-surface view of *3200* (H), from *Umbellularia californica*, Berkeley, California; × 0.36.
2. Section of *3200* shown in fig. 1; × 0.36.
3. Surface of a young rather thin sporophore of *4575* (H), Berkeley, California; × 0.42.
4. Section of *4575* shown in fig. 3; × 0.40.
5. Section of *5972* (H), from *Quercus agrifolia*, Berkeley, California; × 0.39.
6. Section of an old specimen designated "A" in Humphrey herbarium, Berkeley, California; × 0.41.
7. Section of another old specimen designated "B" in Humphrey herbarium, Berkeley, California; × 0.39.
8. Upper surface of a rather young specimen, *161* (Bg), Java; × 0.40.
9. Section of *161* shown in fig. 8; × 0.40.

Plate 7

GANODERMA APPLANATUM (PERS.) PAT. VAR. LAEVISPORUM HUMPH.

FIG. 1. Upper surface of an average-sized specimen, *50084* (B. S.). Type collection from Mount Data, Mountain Province, Luzon, P. I.; × 0.38.
2. Upper surface of the smallest specimen of *50084;* × 0.39.
3. Upper surface of the largest specimen of *50084;* × 0.31.
4. Lower surface of *50084* shown in fig. 3; × 0.32.
5. Upper surface of a rather thick specimen of *50084;* × 0.38.
6. Section of *50084* shown in fig. 5; × 0.38.
7. Upper surface of a somewhat rough specimen of *50084;* × 0.29.
8. Section of *50084* shown in fig. 7; × 0.39.
9. Section of a thin sporophore of *50084;* × 0.39.
10. Upper surface of the largest specimen of *50085* (B. S.), from Benguet, Mountain Province, Luzon, P. I. Also designated as one of the type collections; × 0.31.
11. Lower surface of *50085* shown in fig. 10; × 0.29.
12. Section of *50085* shown in figs. 10 and 11; × 0.38.
13. A medium-sized sporophore of *50085;* × 0.31.
14. Another medium-sized specimen of *50085;* × 0.31.
15. Section of *50085* shown in fig. 14; × 0.38.
16. Upper surface of *7637* (B. S.), Mount Apo, Mindanao, P. I.; × 0.39.
17. Section of *7637* shown in fig. 16; × 0.39.
18. Upper surface of *705* (Bg) *pro parte*, West Java; × 0.39.
19. Section of *705* shown in fig. 18; × 0.38.

Plate 8

GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Upper surface of a large specimen from *Shorea guiso*, *50048* (B. S.), Luzon, P. I. This resembles to a considerable extent the illustration accompanying the type description of *G. lionettii* Rolland; × 0.10.

FIG. 2. Upper surface of *50044* (B. S.), Luzon, P. I. This would be *G. leucophaeum* for Patouillard; × 0.35.
3. Upper surface of *35999* (B. S.), Basilan, P. I. Determined by Lloyd as *Fomes australis* Fr.; × 0.35.
4. Section of *35999* shown in fig. 3; × 0.35.
5. Upper surface of a mature specimen and section of a very young one, *36094* (B. S.), Basilan, P. I. Determined by Lloyd as *Fomes leucophaeus* Mont.; × 0.32.
6. Upper surface of *10556* (B. S.), Polillo, P. I. Determined by Bresadola as *G. subtornatum* Murr. Context typical of variety *philippinense;* × 0.31.
7. Upper surface of a young sporophore, *35998* (B. S.), Basilan, P. I.; × 0.31.
8. Upper surface of a very young thin specimen, *50103* (B. S.), Luzon, P. I.; × 0.35.
9. Section of *50103* shown in fig. 8; × 0.35.
10. Upper surface of a rugose, radially sulcate specimen, *50098* (B. S.), Mindanao, P. I.; × 0.24.
11. Upper surface of a very young specimen without spores, *157* (B. S.), Luzon, P. I. This specimen is not recorded in the present paper since the determination is doubtful. It bears considerable resemblance to young proliferating growth which sometimes occurs at the margin of *G. mastoporum* Lév.; × 0.35.
12. Section of *157* shown in fig. 11; × 0.35.
13. Upper surface of *50079* (B. S.), Mindanao, P. I.; × 0.21.
14. Section of *50079* shown in fig. 13; × 0.21.
15. Upper surface of *714* (B), Luzon, P. I. Determined by Patouillard as *G. leucophaeum* (Mont.); × 0.39.
16. Upper surface of another specimen of *714;* × 0.39.

PLATE 9

GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Side view of a large specimen of *50094* (B. S.), Luzon, P. I.; × 0.19.
2. Section of *50094* shown in fig. 1. With five layers of pores; × 0.16.
3. Upper surface and section of a typical light-weight specimen, *35865* (B. S.), Panay, P. I. Lower surface whitish; × 0.24.
4. Section of *50092* (B. S.), Mindanao, P. I.; × 0.27.
5. Upper surface of two specimens, *36007* (B. S.), Basilan, P. I. Determined by Lloyd as *Fomes tornatus* Pers., but with typical *philippinense* context and spores; × 0.25.
6. Section of *16634* (B. S.), Luzon, P. I. Determined by Bresadola as *Ganoderma subtornatum* Murr.; × 0.21.
7. Upper surface of *50077* (B. S.), Mindanao, P. I.; × 0.32.
8. Section of *4548* (B. S.), Luzon, P. I.; × 0.32.
9. Upper surface of a very young specimen, *50049* (B. S.), Luzon, P. I.; × 0.37.
10. Upper surface of a small specimen, *18388* (B. S.), Biliran, P. I. Rather silvery above. Determined by Sydow as *G. testaceum* Lév.; × 0.35.

FIG. 11. Section of *18388* shown in fig. 10; × 0.35.

12. A young subungulate sporophore just beginning to form pores, *47960* (B. S.), Luzon, P. I. The surface is somewhat scrupose and slightly moldy; × 0.35.
13. Section of *47960* shown in fig. 12; × 0.35.
14. Upper surface of a broadly sulcate specimen with typical context, *50065* (B. S.), Luzon, P. I. This was included in Mrs. Clemens' collection *4550* along with the black specimen shown in Plate 17, fig. 9. The remainder of the specimens were good variety *tornatum* (cf. Plate 17, figs. 10 and 11); × 0.25.
15. Applanate specimens on a large white lauan log in the forest, *50047* (B. S.), Luzon, P. I. The smaller specimens removed from the same trunk are included to show the contrast between the whitish and dark lower surfaces (cf. also Plate 10, figs. 1 to 7, for detail views of other sporophores from the same trunk).

PLATE 10

GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Upper surface of *50047* (B. S.), Luzon, P. I.; × 0.32.

2. Lower surface of *50047* shown in fig. 1; × 0.30.
3. Side view of a very young specimen of *50047* in which the pores are just beginning to form; × 0.33.
4. Section of *50047* shown in fig. 3; × 0.33.
5. Upper surface of a young specimen of *50047* which is concave, pale brown, and rather smooth. This agrees with what Patouillard calls *G. leucophaeum;* × 0.33.
6. Lower surface of *50047* shown in fig. 5; × 0.30.
7. Section of a mature specimen of *50047* which is much thickened at the base and approaches the form shown in Plate 13, fig. 4. Upper surface tuberculose; lower surface whitish. Figs. 1 to 7 represent forms all taken from the side of a large white lauan log in the forests of Mount Maquiling and depict four of the commoner forms in the Philippines; × 0.31.
8. Upper surface of a short stipitate specimen *50051* (B. S.), Luzon, P. I.; × 0.17.
9. Lower surface of *50051* shown in fig. 8. The darker area is brown; × 0.15.

PLATE 11

GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Stipitate specimen which grew from a covered root at the base of a large lauan trunk, *50055* (B. S.), Luzon, P. I.; × 0.17.

2. Section of *50055* shown in fig. 1; × 0.20.
3. Upper surface of specimen collected at Bentong Pahang, Federated Malay States, by E. J. H. Corner, May, 1930. This plant is the nearest approximation to *Ganoderma gibbosum* Nees which the writer has seen; × 0.20.
4. Section of the specimen shown in fig. 3; × 0.23.

FIG. 5. Upper surface of *23225* (S), Federated Malay States; × 0.20.
6. Lower surface of *23225* shown in fig. 5. Blackish brown (R); × 0.20.
7. Section of *23225* shown in figs. 5 and 6; × 0.20.
8. Upper surface of a stipitate specimen, *50041* (B. S.), Mindanao, P. I. Lower surface near to Mars brown; × 0.24.
9. Upper surface of *23229* (S), Federated Malay States. Lower surface whitish; × 0.15.
10. Section of *23229* shown in fig. 9; × 0.16.

PLATE 12

ABERRANT FORMS OF GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Upper surface of *50067* (B. S.), Luzon, P. I. This combines the gross characters of *Ganoderma mastoporum* and varieties *philippinense* and *tornatum*. It is quite distinct on account of the thin *tornatum* context; × 0.29.
2. Upper surface of *50045* (B. S.), Luzon, P. I.; × 0.31.
3. Section of *50045* shown in fig. 2. The context is much bleached and there is considerable yellowish in the blend of colors; × 0.31.
4. Upper surface of *50052* (B. S.), Luzon, P. I. Under surface slate colored; upper surface tuberculose. Typical; × 0.28.
5. Sulcate form of *50052*. Upper surface somewhat silvery, banded with light drab; lower surface slate; × 0.22.
6. Immature ungulate specimens of *50052* in which the pores are just beginning to form; × 0.22.
7. Section of one of the ungulate sporophores of *50052;* × 0.31.
8. Front view of a young sporophore of *50052*. Figs. 4 to 8 represent specimens taken from around the base of a large rotten stub of *Parashorea malaanonan* or on large limbs fallen from the same tree and lying around the base; × 0.31.
9. Section of *35867* (B. S.), Panay, P. I. Similar to the base species but with the typical context of variety *philippinense;* × 0.25.
10. Spatulate stipitate specimen with the typical context of *philippinense* but with the pore mouths of *G. mastoporum, 8665* (Bg), Borneo; × 0.33.
11. Section of *8665* shown in fig. 10; × 0.30.
12. Sections of two specimens from Java, *5479* (H). These are close to the base species and were so determined by Dr. E. A. Burt; × 0.31.

PLATE 13

ABERRANT FORMS OF GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Oblique view of *50071* (B. S.), Luzon, P. I. A young, soft, lightweight specimen, whitish beneath; × 0.33.
2. Upper surface of *50073* (B. S.), Luzon, P. I.; × 0.20.
3. Lower surface of *50073* shown in fig. 2; × 0.20.

FIG. 4. Section of *50073* shown in figs. 2 and 3; × 0.30.
5. Upper surface of *50075* (B. S.), Luzon, P. I.; × 0.25.
6. Upper surface and section of *47956* (B. S.), Luzon, P. I.; × 0.34.
7. Upper surface of a laterally stipitate specimen, *Elmer 14255* (B), Mindanao, P. I.; × 0.34.
8. Section of *Elmer 14255* shown in fig. 7; × 0.33.
9. Upper surface of *50056* (B. S.), Mindanao, P. I.; × 0.31.
10. Lower surface of *50056* shown in fig. 9; × 0.32.
11. Section of *50056* shown in figs. 9 and 10; × 0.34.
12. Small young specimen of *50074* (B. S.), Luzon, P. I.; × 0.30.
13. Section of *50074* shown in fig. 12; × 0.32.
14. Upper surface of a mature specimen of *50074;* × 0.30.
15. Section of *50074* shown in fig. 14; × 0.32.

PLATE 14

ABERRANT FORMS OF GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

FIG. 1. Upper surface of a very hard heavy sporophore, *50069* (B. S.), Luzon, P. I.; × 0.32.
2. Lower surface of *50069* shown in fig. 1; × 0.31.
3. Section of *50069* shown in figs. 1 and 2. The context has a yellowish brown appearance due to the higher percentage of tawny olive and cinnamon brown in the blend of colors; × 0.28.
4. Upper surface of *50127* (B. S.), Luzon, P. I.; × 0.25.
5. Section of *36046* (B. S.), Basilan, P. I. Determined by Lloyd as *Fomes oroflavus* Lloyd. This approaches variety *tornatum* forma *macrospora* in context and spores, but has the fawn-colored streaks of *philippinense;* × 0.33.
6. Section of another specimen of *36046*. This has the *philippinense* context, which agrees quite well with that of the specimen shown in fig. 3; × 0.33.
7. Section of *50070* (B. S.), Luzon, P. I. The context is rather hard, and yellowish brown; × 0.29.
8. Upper surface of a short-stipitate specimen, *50062* (B. S.) Luzon, P. I. This looks like a giant form of *G. mastoporum*, but the pores are not typical and the context is good *philippinense*. It has a thick, hard, blackish crust; × 0.22.
9. Lower surface of *50062* shown in fig. 8; × 0.22.

PLATE 15

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS.

FIG. 1. Upper surface of a broadly applanate specimen, *2050* (B. S.), Amboina; × 0.28.
2. Lower surface of *2050* shown in fig. 1. The old portion is blackened; the young superimposed growth is buff in color; × 0.28.
3. Edge of another specimen of *2050* showing the older portion insect-eaten, with a new pileus forming below. This condition is frequent in *G. lobatum* but otherwise is rare; × 0.15.
4. Section of *2050* shown in figs. 1 and 2; × 0.28.

FIG. 5. Upper surface of *6092* (B. S.), Samar, P. I.; × 0.35.
6. Upper surface of *50006* (B. S.), Luzon, P. I.; × 0.35.
7. Section of *50006* shown in fig. 6; × 0.35.

PLATE 16

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS.

FIG. 1. Upper surface of *50015* (B. S.), Luzon, P. I.; × 0.28.
2. Lower surface of *50015* shown in fig. 1. Yellowish; × 0.27.
3. Two sections from the same collection, *36130* (B. S.), Mindanao, P. I.; × 0.29.
4. Upper surface of a somewhat rosetted specimen, *4547* (B. S.), Luzon, P. I.; × 0.29.
5. Specimen on dead sapling photographed by Dr. O. A. Reinking, August 7, 1919. Probably from Los Baños, P. I.
6. Upper surface of *4583* (B. S.), Luzon, P. I.; × 0.29.
7. Section of *4583* shown in fig. 6; × 0.28.
8. Upper surface of *12161* (H), Mindanao, P. I.; × 0.29.
9. Section of *12161* shown in fig. 8; × 0.29.
10. Upper surface of *50016* (B. S.), Luzon, P. I.; × 0.23.
11. Section of *50016* shown in fig. 10; × 0.23.
12. Upper surface of a lobed sporophore, *50018* (B. S.), Luzon, P. I.; × 0.19.
13. Section of *35979* (B. S.), Mindanao, P. I.; × 0.17.
14. Upper surface of a laterally stipitate specimen, *50022* (B. S.), Palawan, P. I.; × 0.24.
15. Upper surface of a specimen closely resembling *G. applanatum* *50013* (B. S.), Mindanao, P. I.; × 0.29.

PLATE 17

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS., EXCEPT FIG. 9, WHICH IS VARIETY PHILIPPINENSE.

FIG. 1. Upper surface of *50031* (B. S.), Luzon, P. I.; × 0.15.
2. Section of *50031* shown in fig. 1 and section of a thin sporophore from the same collection; × 0.23.
3. Upper surface of *47929* (B. S.), Palawan, P. I.; × 0.29.
4. Section of *47929* shown in fig. 3; × 0.29.
5. Upper surface of another specimen of *47929;* × 0.29.
6. Section of *47929* shown in fig. 5; × 0.29.
7. Upper surface of a rather thick specimen, *50032* (B. S.), Luzon, P. I.; × 0.24.
8. Section of *50032* shown in fig. 7. Note the bleached pores; × 0.33.
9. Upper surface of an old blackened specimen included in *4550* (B. S.), but which is referable to variety *philippinense.* Reported under *50064,* Luzon, P. I.; × 0.23.
10. Upper surface of two specimens, *4550* (B. S.), Luzon, P. I.; × 0.29.
11. Section of upper specimen of *4550* shown in fig. 10; × 0.29.
12. Upper surface and section of *50009* (B. S.), Luzon, P. I.; × 0.29

FIG. 13. Upper surface of *50036* (B. S.), Luzon, P. I.; × 0.29.
14. Section of *50036* shown in fig. 13; × 0.33.
15. Small ungulate sporophore, *50017* (B. S.), Mindanao, P. I.; × 0.29.
16. Section of *50017* shown in fig. 15; × 0.29.
17. Upper surface of applanate specimen of *50017;* × 0.29.
18. Upper surface of another applanate specimen of *50017;* × 0.29.
19. Section of *50017* shown in fig. 18; × 0.29.
20. Section of a thick specimen with bleached pores, *16028* (B. S.), Luzon, P. I. Determined by Lloyd as *Fomes applanatus;* × 0.30.
21. Section of another thick specimen, *50005* (B. S.), Luzon, P. I.; × 0.29.
22. Upper surface of a thin proliferating specimen, *50008* (B. S.), P. I.; × 0.23.
23. Upper surface of two other specimens of *50008;* × 0.29.
24. Section of *14376* (B. S.), Luzon, P. I. Determined by Graff as *Ganoderma applanatum* (Pers.) Bres.; confirmed by Lloyd; × 0.29.
25. Section of *659* (B.), Luzon, P. I. Determined by Patouillard; × 0.30.
26. Section of *4461* (B), Luzon, P. I. Determined by Patouillard; × 0.29.

PLATE 18

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS.

Various sporophores collected from the log, Mount Maquiling, near Los Baños, P. I. The sections are not reduced as much as the sporophores and are lettered to correspond with the specimen from which derived. *Bu. Sci. 50028.* Upper surfaces × 0.32; sections × 0.55.

PLATE 19

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS., EXCEPT FIGS. 9 AND 10, WHICH ARE FORMA MACROSPORA

FIG. 1. Upper surface of a small sessile and a stipitate sporophore, *3634* (B), Luzon, P. I. Determined by Lloyd as *Fomes applanatus;* × 0.32.
2. Upper surface of a stipitate specimen, *50007* (B. S.), Panay, P. I.; × 0.35.
3. Lower surface of *50007* shown in fig. 2; × 0.35.
4. Upper surface of a long-stipitate specimen, *50010* (B. S.), P. I.; × 0.35.
5. Upper surface of five young specimens, *1662* (B), Luzon, P. I. Determined by Patouillard as *Ganoderma testaceum* Lév.; × 0.32.
6. Upper surface and section of a single specimen, Togo, Africa (B. S.), from Berlin Museum; × 0.35.
7. Upper surface of *5537* (Bg), Java. A light-weight plant; × 0.28.
8. Section of *5537* shown in fig. 7; × 0.33.

FIG. 9. Upper surface of variety *tornatum* forma *macrospora*, *17808* A (S), Federated Malay States; × 0.34.
10. Section of *17808* A shown in fig. 9; × 0.36
11. An immature globose specimen with the pores just beginning to develop, *50011* (B. S.), Luzon, P. I.; × 0.35.
12. Section of *50011* shown in fig. 11; × 0.35.
13. Section of young applanate specimen from the same collection, *50011;* × 0.35.
14. Upper surface of *5677* (S), Federated Malay States; × 0.33.
15. Section of *5677* shown in fig. 14; × 0.36.
16. Upper surface of *4985* (S), Federated Malay States; × 0.28.
17. Section of *4985* shown in fig. 16; × 0.37.

PLATE 20

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS. FORMA MACROSPORA HUMPH.

FIG. 1. Upper surface of *50089* (B. S.), Luzon, P. I.; × 0.34.
2. Section of *50089* shown in fig. 1; × 0.44.
3. Upper surface of *50088* (B. S.), Luzon, P. I.; × 0.32.
4. Lower surface of *50088* shown in fig. 3; × 0.32.
5. Upper surface of stipitate specimen *6211* (Bg), West Java. Doubtfully referred here; × 0.38.
6. Lower surface of *6211* shown in fig. 5; × 0.43.
7. Upper surface of a stipitate and a sessile specimen, *5819* (Bg), West Java. An aberrant specimen; × 0.38.
8. Section of sessile specimen of *5819* shown in fig. 7; × 0.39.
9. Upper surface of *1619* (Bg), West Java. Determined by Lloyd as *Fomes koningsbergii* Lloyd; × 0.38.
10. Section of *1619* shown in fig. 9; × 0.41.
11. Upper surface of *5497* (Bg), West Java; × 0.38.
12. Section of *5497* shown in fig. 11; × 0.39.

PLATE 21

GANODERMA LOBATUM (SCHW.) ATK.

FIG. 1. Upper surface of *6884* (H), Indiana; × 0.33.
2. Upper surface of another specimen of *6884;* × 0.33.
3. Upper surface of still another specimen of *6884;* × 0.33.
4. Section of *6884* shown in fig. 2; × 0.35.
5. Upper surface of *9670* (H), Illinois; × 0.35.
6. Upper surface of *10583* (H), Alabama; × 0.35.
7. Section of *10583* shown in fig. 6; × 0.35.
8. Upper surface of *7007* (H), from mine in Alabama; × 0.35.
9. Section of *7007* shown in fig. 8; × 0.35.
10. Upper surface of *1202* (H), Illinois; × 0.35.
11. Section of *1202* shown in fig. 10; × 0.35.
12. Section of *1343* (H), Illinois; × 0.36.
13. Upper surface of a large sporophore of *6983* (H), Florida; × 0.37.
14. Section of *6983* shown in fig. 13; × 0.35.
15. Upper surface of a smaller sporophore of *6983;* × 0.35.
16. Lower surface of *6983* shown in fig. 15; × 0.35.

FIG. 17. Section of *6983* shown in figs. 15 and 16; × 0.35.
18. Upper surface of a stipitate specimen, *2853*, Cuba; × 0.35.
19. Section of *2853* shown in fig. 18; × 0.33.

PLATE 22

PORE SURFACES OF GANODERMA APPLANATUM (PERS.) PAT.

FIG. 1. From Iowa, U. S., *2344* (H); × 8.
2. From Maine, U. S., *962* (B. S.); × 20.
3. From England, Kew Botanical Garden (B. S.); × 8.
4. From England, Kew Botanical Garden. Same specimen as shown in fig. 3; × 20.
5. From Austria, *Kryptogamae exsiccatae* [Vienna], *940* (B. S.); × 20.
6. From Australia, National Herbarium of New South Wales, *5990* (B); × 20.
7. From Japan, *12583* (H); × 20.
8. From Japan, *Hemmi 25* (H); × 20.
9. From Hongkong, China, *11623* (H); × 20.
10. From Formosa, *Sawada 78* (H). Showing large and small pores side by side in the same specimen; × 20.
11. From Uganda, Africa, *Maitland 377* (H); × 20.
12. From Nova Petropolis, Brazil, *10754* (H); × 20.
13. From the Philippines, *16195* (B. S.); × 20.

PLATE 23

PORE SURFACES

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *brownii* Murr. from California, *3200* (H); × 20.
2. *Ganoderma applanatum* (Pers.) Pat. var. *laevisporum* Humph. from the Mountain Province, Luzon, P. I., *50086* (B. S.); × 20.
3. Variety *laevisporum* from the Mountain Province, Luzon, P. I., *50085* (B. S.). Specimen from the type collection; × 20.
4. *Ganoderma applanatum* (Pers.) Pat. var. *philippinense* Humph. from Luzon, P. I., *50045* (B. S.). Pore surface brownish slate color; × 8.
5. Variety *philippinense* from Luzon, P. I., *50047* (B. S.), with a light-colored pore surface; × 20.
6. Another specimen of variety *philippinense* from *50047*, with a dark brown pore surface; × 20.
7. Variety *philippinense* from Panay, P. I., *35882* (B. S.), with a light-colored pore surface; × 20.
8. Variety *philippinense* from Luzon, P. I., *50057* (B. S.), with a brown pore surface; × 20.
9. Variety *philippinense* from Panay, P. I., *35867* (B. S.), with a light brown pore surface; × 20.
10. Variety *philippinense* from Mindanao, P. I., *50092* (B. S.), with a light-colored pore surface; × 20.
11. Variety *philippinense* from Luzon, P. I. *4548* (B. S.), with a light-colored pore surface; × 20.

FIG. 12. Variety *philippinense* from Luzon, P. I., *50127* (B. S.), with a slate-colored pore surface; × 20.
13. Variety *philippinense* from Mindanao, P. I., *50093* (B. S.), with a brownish slate pore surface; × 20.
14. Variety *philippinense* from Luzon, P. I., *4551* (B. S.), with a dark brown pore surface; × 20.
15. Variety *philippinense* from Luzon, P. I., *50045* (B. S.), with a brownish slate pore surface. Compare fig. 4. The photographs are taken from the same sporophore, but with different methods of illumination. The orifices are funnel-shaped; × 20.
16. Variety *philippinense* from Luzon, P. I., *42075* (B. S.), with a brown pore surface; × 20.
17. Variety *philippinense* from Luzon, P. I., *50103* (B. S.). A very young specimen with light-colored pore surface; × 20.

PLATE 24

PORE SURFACES

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers., *50023* (B. S.), from Palawan, P. I. Pores with very small orifice and thick dissepiments; × 20.
2. Section of the pores of *50023* shown in fig. 1. The pores are larger than those at the surface, which are somewhat closed by an inward growth of mycelium; × 20.
3. Variety *tornatum* Pers., *50002* (B. S.), from Samar, P. I.; × 20.
4. Variety *tornatum* Pers., *1596* (B. S.), from Luzon, P. I.; × 20.
5. Variety *tornatum* Pers., *19236* (B S.), from Luzon, P. I.; × 20.
6. Variety *tornatum* Pers., from Togo, Africa (B. S.), from Berlin Museum; × 20.
7. Variety *tornatum* Pers., forma *macrospora* Humph., *2048* (B. S.), from Mindanao, P. I.; × 20.
8. Variety *tornatum* Pers., forma *macrospora* Humph, *2048*. Section well below the surface showing larger pores as compared with the somewhat occluded ones at the surface shown in fig. 7; × 20.
9. Variety *tornatum* Pers. forma *macrospora* Humph., *20389* (B. S.), from Luzon, P. I.; × 20.
10. *Ganoderma lobatum* (Schw.) Atk., *1343* (H), from Illinois; × 8.
11. *Ganoderma lobatum* (Schw.) Atk., *6884* (H), from Indiana; × 8.
12. *Ganoderma lobatum* (Schw.) Atk., *6884*; × 20.
13. *Ganoderma lobatum* (Schw.) Atk., *9670* (H), from Illinois; × 20.

PLATE 25

LONGISECTIONS OF CRUST, CONTEXT, AND PORES; × 4

FIG. 1. *Ganoderma applanatum* (Pers.) Pat., *2344* (H), from Iowa.
2. *Ganoderma applanatum* (Pers.) Pat., *Cleland 27* (H), from New South Wales, Australia.
3 *Ganoderma applanatum* (Pers.) Pat. var. *brownii* Murr. Specimen designated "A" in herb. Humphrey, from California.
4. *Ganoderma applanatum* (Pers.) Pat. var. *tornatum* Pers., from Togo, Africa (B. S.), from Berlin Museum.

FIG. 5. *Ganoderma applanatum* (Pers.) Pat. *12583* (H), from Japan, showing the harder black streaks.
6. *Ganoderma lobatum* (Schw.) Atk., *1343* (H), from Illinois, showing abundant harder black streaks at the base of the pileus.
7. *Ganoderma applanatum* (Pers.) Pat. from England (B. S.), from the Kew Herbarium.

PLATE 26

LONGISECTIONS OF CRUST, CONTEXT, AND PORES OF GANODERMA APPLANATUM (PERS.) PAT. VAR. LAEVISPORUM HUMPH.; × 4

FIG. 1. Section of an average-sized specimen of *50085* (B. S.). Type collection from Benguet, Mountain Province, Luzon, P. I.
2. Section of a medium-sized specimen of *50084* (B. S.), from Mount Data, Mountain Province, Luzon, P. I. Also designated as one of the type collections.
3. Section of the thickest and largest specimens of *50084*.
4. Section of a thin sporophore of *50084*.
5. Section of the smallest specimen of *50084*.
6. Section of an old sporophore of *50084*. Pore layer very much cracked and eroded.

PLATE 27

LONGISECTIONS OF CRUST, CONTEXT, AND PORES

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var *philippinense* Humph., *50092* (B. S.), from Mindanao, P. I.; × 4.
2. Variety *philippinense* Humph., *36046* (B. S.), from Basilan, P. I.; × 4.
3. Variety *philippinense* Humph., *50045* (B. S.), from Luzon, P. I.; × 4.
4. Variety *philippinense* Humph., *50047* (B. S.), from Luzon, P. I. Section at extreme edge of a pore from specimen with dark lower surface; × 393.
5. Variety *philippinense* Humph., *50047*. Section at extreme edge of a pore from a specimen with light-colored lower surface; × 393.
6. *Ganoderma lobatum* (Schw.) Atk., *6884* (H), from Indiana; × 4.
7. *Ganoderma lobatum* (Schw.) Atk., *1343* (H), from Illinois; × 4.

PLATE 28

SECTIONS OF CONTEXT; × 393

FIG. 1. *Ganoderma applanatum* (Pers.) Pat. var. *philippinense* Humph., *50042* (B. S.), from Luzon, P. I. Photomicrograph of section of the edge of a bleached spot in the context showing the larger normal brown hyphæ and the fine nearly colorless ones.
2. Variety *philippinense* Humph., *50042*. Section from within another bleached spot.
3. Variety *philippinense*, *50042*. Radial section from the normal brown context.

Plate 29

Photomicrographs of Radial Sections of the Crust; × 121

Fig. 1. *Ganoderma applanatum* (Pers.) Pat., *2348* (H). Specimen with bleached context from *Tsuga heterophylla*, Washington.
2. Variety *brownii* Murr., designated "B" in herb. Humphrey, from California.
3. Variety *laevisporum* Humph., *50085* (B. S.). Type collection from Mountain Province, Luzon, P. I.
4. Variety *philippinense* Humph., *50042* (B. S.), from Luzon, P. I.
5. Variety *tornatum* Pers., *50004* (B. S.), from Palawan, P. I. The crust is quite typical and rather difficult to indent with the thumb nail.
6. Variety *tornatum* Pers., *50028* (B. S.), from Luzon, P. I. Crust rather thin and easily indented.
7. Variety *tornatum* Pers. forma *macrospora* Humph., *50089* (B. S.), from Luzon, P. I. Crust medium thick and difficult to indent.
8. *Ganoderma lobatum* (Schw.) Atk., from North Carolina, herb. Schweinitz *409–90*. Type.
9. *Ganoderma lobatum* (Schw.) Atk., *9670* (H), from Illinois.

Plate 30

Photomicrographs of Cross Sections of Pores

Fig. 1. *Ganoderma applanatum* (Pers.) Pat. *2348* (H), from Washington; × 121.
2. Variety *brownii* Murr., designated "B" in herb. Humphrey, from California; × 121.
3. Variety *laevisporum* Humph., *50085* (B. S.). Type collection from Mountain Province, Luzon, P. I.; × 121.
4. Variety *philippinense* Humph., *50042* (B. S.), from Luzon, P. I.; × 121.
5. Variety *tornatum* Pers., *50004* (B. S.), from Palawan, P. I.; × 121.
6. Variety *tornatum* Pers., *2518* (B), from Luzon, P. I.; × 180.
7. Variety *tornatum* Pers. forma *macrospora* Humph., *50089* (B. S.), from Luzon, P. I.; × 121.
8. *Ganoderma lobatum* (Schw.) Atk., *9670* (H), from Illinois; × 121.

Plate 31

Photomicrographs of Longisections of Pores and Context; × 121

Fig. 1. *Ganoderma applanatum* (Pers.) Pat., *2348* (H), from Washington.
2. *Ganoderma applanatum* (Pers.) Pat. *2348* (H). Section of the bleached context showing the fine colorless hyphæ.
3. Variety *brownii* Murr., designated "B" in herb. Humphrey, from California.
4. Variety *laevisporum* Humph., *50085* (B. S.), type collection from the Mountain Province, Luzon, P. I.
5. Variety *philippinense* Humph., *50042* (B. S.), from Luzon, P. I.

FIG. 6. Variety *tornatum*, Pers. *50004* (B. S.), from Palawan, P. I.
7. Variety *tornatum* Pers. forma *macrospora* Humph., *50089* (B. S.), from Luzon, P. I.
8. *Ganoderma lobatum* (Schw.) Atk., from North Carolina, herb. Schweinitz *409–90*. Type.
9. *Ganoderma lobatum* (Schw.) Atk., *9670* (H), from Illinois.

PLATE 32

SPORES OF GANODERMA APPLANATUM (PERS.) PAT.; × 780.

FIG. 1. From upper surface of *2348* (H), Washington.
2. From upper surface of *6083* (H), Oregon.
3. From crushed pores of *882* (H), Wisconsin.
4. The usual type of spores from the crushed pores of an English specimen from the Kew Herbarium.
5. A group of very large darker spores from the crushed pores of the same English specimen as in fig. 4.
6. From the crushed pores of *12502* (H), Japan.
7. From the upper surface of *12583* (H), Japan.
8. From the crushed pores of *11537* (H), Japan.
9. From the upper surface of *Sawada 68* (H), Formosa.
10. From the upper surface of *Cleland 9* (H), Flinders Island, Australia.
11. From the upper surface of *Cleland 1* (H), South Australia.
12. From the upper surface of *Cleland 3* (H), New South Wales, Australia.

PLATE 33

SPORES OF GANODERMA APPLANATUM (PERS.) PAT. AND VAR. BROWNII MURR.; × 780

FIG. 1. From the crushed pores of *applanatum, Cleland 5* (H), New South Wales, Australia.
2. From the upper surface of *applanatum, Cleland 11* (H), Queensland, Australia.
3. From the upper surface of *applanatum, 10754* (H), Brazil.
4. From the upper surface of *applanatum, 11053* (H), Brazil.
5. From the upper surface of *applanatum, Maitland 377* (H), Uganda, Africa.
6. From the upper surface of *applanatum, 32664* (B. S.), Panay, P. I.
7. From the crushed pores of *applanatum, 8734* (B. S.), Mountain Province, Luzon, P. I.
8. From the upper surface of *applanatum, 50102* (B. S.), Luzon, P. I.
9. From the upper surface of variety *brownii, 3199* (H), California.
10. From the upper surface of variety *brownii, 3200* (H), California.
11. From crushed pores of variety *brownii*, Bornmuller, *Pl. exs. canarienses 1900, 45*, Teneriffe, Canary Islands.
12. From the upper surface of variety *brownii, 161* (Bg), Java.

PLATE 34

SPORES OF GANODERMA APPLANATUM (PERS.) PAT. VAR. LAEVISPORUM HUMPH. AND VAR. PHILIPPINENSE HUMPH.; × 780

FIG. 1. From the upper surface of variety *laevisporum, 50086* (B. S.), Mountain Province, Luzon, P. I.
2. From the upper surface of variety *laevisporum, 50084* (B. S.), Mountain Province, Luzon, P. I. Type collection.
3. From the upper surface of variety *philippinense, 50057* (B. S.), Luzon, P. I.
4. From the upper surface of variety *philippinense, 4551* (B. S.), Luzon, P. I.
5. From the upper surface of variety *philippinense, 10556* (B. S.), Polillo, P. I. Determined by Bresadola as *G. subtornatum* Murr.
6. From the crushed pores of variety *philippinense, 10556.*
7. From the upper surface of variety *philippinense, 2578* (B. S.), Luzon, P. I.
8. From the upper surface of variety *philippinense, 50070* (B. S.), Luzon, P. I.
9. From the upper surface of variety *philippinense, 50062* (B. S.), Luzon, P. I.
10. From the upper surface of variety *philippinense, 35865* (B. S.), Panay, P. I.
11. Young spores from the upper surface of variety *philippinense, 35865* (B. S.) Cf. fig. 10.
12. From the crushed pores of variety *philippinense, 23225* (S), Federated Malay States.

PLATE 35

SPORES OF GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS.; × 780

FIG. 1. From the upper surface of *Bur. Sci. 14376* (B), Luzon, P. I.
2. From the upper surface of *50125* (B. S.), P. I.
3. From the upper surface of *2955* (B), Luzon, P. I.
4. From the upper surface of *Bur. Sci. 21596* (B), Palawan, P. I.
5. From the upper surface of *3415* (B), Luzon, P. I.
6. From the upper surface of *4550* (B. S.), Luzon, P. I.
7. From the upper surface of *50033* (B. S.), Mindanao, P. I.; × 1166.
8. From the upper surface of *19202* (S), Borneo.
9. From the upper surface of *5537* (Bg), Java.
10. From the crushed pores of *5494* (S), Federated Malay States. Note the typical pointed young spore that appears somewhat larger. This is quite characteristic of many young spores in this variety.
11. From the upper surface of specimen from Togo, Africa (B. S.), from Berlin Museum.
12. From the upper surface of *Cleland 6* (H), Queensland, Australia.

[illegible]

[illegible] Bureau of Agriculture, Philippine Islands. [illegible]

Fig. 1. From the upper surface of [illegible]. [illegible]

2. From the upper surface of [illegible]. [illegible]

3. From the upper surface of [illegible]. [illegible]

4. From the upper surface of [illegible]. [illegible]

5. From the upper surface of [illegible]. [illegible]

6. From the upper surface of [illegible]. [illegible]

7. From the mounted [illegible] of the type specimen of [illegible]. [illegible]

8. From the upper [illegible] of [illegible]. [illegible]

9. From the upper surface of [illegible]. [illegible]

10. From the upper surface of [illegible]. [illegible]

11. From the upper surface of [illegible]. [illegible]

12. From the upper surface of [illegible]. [illegible]

[illegible]

Fig. 1. Symptoms of [illegible] [illegible] showing [illegible] and [illegible] [illegible]. [illegible]

[illegible]

Plate 1. [illegible].

Plate 2. [illegible].

Plate 3. [illegible].

Plate 4. [illegible].

Plate 5. [illegible].

Plate 6. [illegible].

Plate 7. [illegible].

Plate 8. [illegible].

Plate 9. [illegible].

Plate 10. [illegible].

Plate 11. [illegible].

Plate 12. [illegible].

Plate 13. [illegible].

Plate 14. [illegible].

Plate 15. [illegible].

Plate 16. [illegible].

Plate 17. [illegible].

Plate 18. [illegible].

Plate 19. [illegible].

Plate 20. [illegible].

Plate 21. [illegible].

Plate 22. [illegible].

Plate 23. [illegible].

Plate 24. [illegible].

Plate 25. [illegible].

Plate 26. [illegible].

Plate 27. [illegible].

Plate 28. [illegible].

Plate 29. [illegible].

Plate 30. [illegible].

Plate 31. [illegible].

Plate 32. [illegible].

Plate 33. [illegible].

Plate 34. [illegible].

Plate 35. [illegible].

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[illegible] OF [illegible] FIGURES ON MOUNTAIN SIGNAL PLATES

[illegible] [illegible] (Plate) For

UNITED STATES

[illegible] (K); Iowa; Plate 1, figs. 8 and 9; Plate 22, fig. 1; Plate 25, fig. 1.

[illegible] (K), Washington; Plate 24, fig. 1; Plate 30, fig. 1; Plate 31, figs. 1 and 2; Plate 32, fig. 1.

ENGLAND

Specimen from the Law Collection (E. L.); Plate 1, fig. 10; Plate 21, figs. 3 and 4; Plate 31, fig. 1; Plate 32, figs. 4 and 5.

JAPAN

Kawaji [illegible] (K); Plate 2, fig. 6; Plate 21, fig. 2.
[illegible] (K); Plate 1, figs. 11 and 12; Plate 22, fig. 2.
[illegible] (K); Plate 2, fig. 14; Plate 31, fig. 1; Plate 32, fig. 3; Plate 33, fig. 1.

CHILE

[illegible] (K); Plate 2, figs. 5 and 6; Plate 22, fig. 3.

FLORIDA

Kendall [illegible] (K); Plate 2, fig. 12; Plate 32, fig. 10.

AUSTRALIA

Diamond 1 (K); Plate 1, figs. 1 and 2; Plate 22, fig. 11.
Diamond 2 (K); Plate 1, figs. 3 and 4; Plate 23, fig. 12.
Diamond 3 (K); Plate 2, fig. 7; Plate 22, fig. 14.
Diamond 21 (K); Plate 2, figs. 13 and 14; Plate 32, fig. 2.

BRAZIL

[illegible] (K); Plate 4, fig. 4; Plate 23, fig. 13; Plate 31, fig. 2.
[illegible] (K); Plate 4, fig. 5; Plate 23, fig. 4.

MEXICO

Mallard 27 (K); Plate 22, fig. 11; Plate 23, fig. 5.

PHILIPPINES

[illegible] (K. S.); Plate 5, fig. 4; Plate 22, fig. 15.
[illegible] (K. S.); Plate 5, figs. 13 and 14; Plate 23, fig. 6.

[illegible] [illegible] (Plate) For [illegible] [illegible]

UNITED STATES

Column "A" in Rock Canyon, California; Plate 4, fig. 1; Plate 21, fig. 1

Collection "B" in herb. Humphrey, California; Plate 6, fig. 7; Plate 29, fig. 2; Plate 30, fig. 2; Plate 31, fig. 3.

3200 (H), California; Plate 6, figs. 1 and 2; Plate 23, fig. 1; Plate 33, fig. 10.

JAVA

161 (Bg.); Plate 6, figs. 8 and 9; Plate 33, fig. 12.

GANODERMA APPLANATUM (PERS.) PAT. VAR. LAEVISPORUM HUMPH.

PHILIPPINES

50084 (B. S.); Plate 7, figs. 1 to 9; Plate 34, fig. 2.

50085 (B. S.); Plate 7, figs. 10 to 15; Plate 23, fig. 3; Plate 29, fig. 3; Plate 30, fig. 3; Plate 31, fig. 4.

50086 (B. S.); Plate 23, fig. 2; Plate 34, fig. 1.

GANODERMA APPLANATUM (PERS.) PAT. VAR. PHILIPPINENSE HUMPH.

PHILIPPINES

4551 (B. S.); Plate 23, fig. 14; Plate 34, fig. 4.

10556 (B. S.); Plate 8, fig. 6, Plate 34, figs. 5 and 6.

35865 (B. S.); Plate 9, fig. 3; Plate 34, figs. 10 and 11.

35867 (B. S.); Plate 12, fig. 9; Plate 23, fig. 9.

36046 (B. S.); Plate 14, figs. 5 and 6; Plate 27, fig. 2.

50042 (B. S.); Plate 28, figs. 1 to 3; Plate 29, fig. 4; Plate 30, fig. 4; Plate 31, fig. 5.

50045 (B. S.); Plate 12, figs. 2 and 3; Plate 23, figs. 4 and 15; Plate 27, fig. 3.

50047 (B. S.); Plate 9, fig. 15; Plate 10, figs. 1 to 7; Plate 23, figs. 5 and 6; Plate 27, figs. 4 and 5.

50057 (B. S.); Plate 23, fig. 8; Plate 34, fig. 3.

50062 (B. S.); Plate 14, figs. 8 and 9; Plate 34, fig. 9.

50070 (B. S.); Plate 14, fig. 7; Plate 34, fig. 8.

50092 (B. S.); Plate 9, fig. 4; Plate 23, fig. 10; Plate 27, fig. 1.

50093 (B. S.); Plate 8, fig. 10; Plate 23, fig. 13.

50103 (B. S.); Plate 8, figs. 8 and 9; Plate 23, fig. 17.

50127 (B. S.); Plate 14, fig. 4; Plate 23, fig. 12.

FEDERATED MALAY STATES

23225 (S); Plate 11, figs. 5 to 7; Plate 34, fig. 12.

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS.

PHILIPPINES

4550 (B. S.); Plate 17, figs. 10 and 11; Plate 35, fig. 6.

14376 (B. S.); Plate 17, fig. 24; Plate 35, fig. 1.

50004 (B. S.); Plate 29, fig. 5; Plate 30, fig. 5; Plate 31, fig. 6.

50028 (B. S.); Plate 18; Plate 29, fig. 6.

AFRICA

Specimen from Togo from Berlin Museum (B. S.); Plate 19, fig. 6; Plate 24, fig. 6; Plate 25, fig. 4; Plate 35, fig. 11.

JAVA

5537 (Bg); Plate 19, figs. 7 and 8; Plate 35, fig. 9.

GANODERMA APPLANATUM (PERS.) PAT. VAR. TORNATUM PERS. FORMA MACROSPORA HUMPH.

PHILIPPINES

2048 (B. S.); Plate 24, figs. 7 and 8; Plate 36, fig. 3.
50088 (B. S.); Plate 20, figs. 3 and 4; Plate 36, fig. 1.
50089 (B. S.); Plate 20, figs. 1 and 2; Plate 29, fig. 7; Plate 30, fig. 7; Plate 31, fig. 7; Plate 36, fig. 2.

FEDERATED MALAY STATES

17808 A (S); Plate 19, figs. 9 and 10; Plate 36, fig. 4.

JAVA

5497 (Bg); Plate 20, figs. 11 and 12; Plate 36, fig. 5.
6211 (Bg); Plate 20, figs. 5 and 6; Plate 36, fig. 6.

GANODERMA LOBATUM (SCHW.) ATK.

UNITED STATES

409–90, Schweinitz type from North Carolina (H); Plate 29, fig. 8; Plate 31, fig. 8; Plate 36, fig. 7.
1343 (H), Illinois; Plate 21, fig. 12; Plate 24, fig. 10; Plate 25, fig. 6; Plate 27, fig. 7; Plate 36, fig. 11.
6884 (H), Indiana; Plate 21, figs. 1 to 4; Plate 24, figs. 11 and 12; Plate 27, fig. 6; Plate 36, fig. 9.
6983 (H), Florida; Plate 21, figs. 13 to 17; Plate 36, fig. 10.
7007 (H), Alabama; Plate 21, figs. 8 and 9; Plate 36, fig. 8.
9670 (H), Illinois; Plate 21, fig. 5; Plate 24, fig. 13; Plate 29, fig. 9; Plate 30, fig. 8; Plate 31, fig. 9.

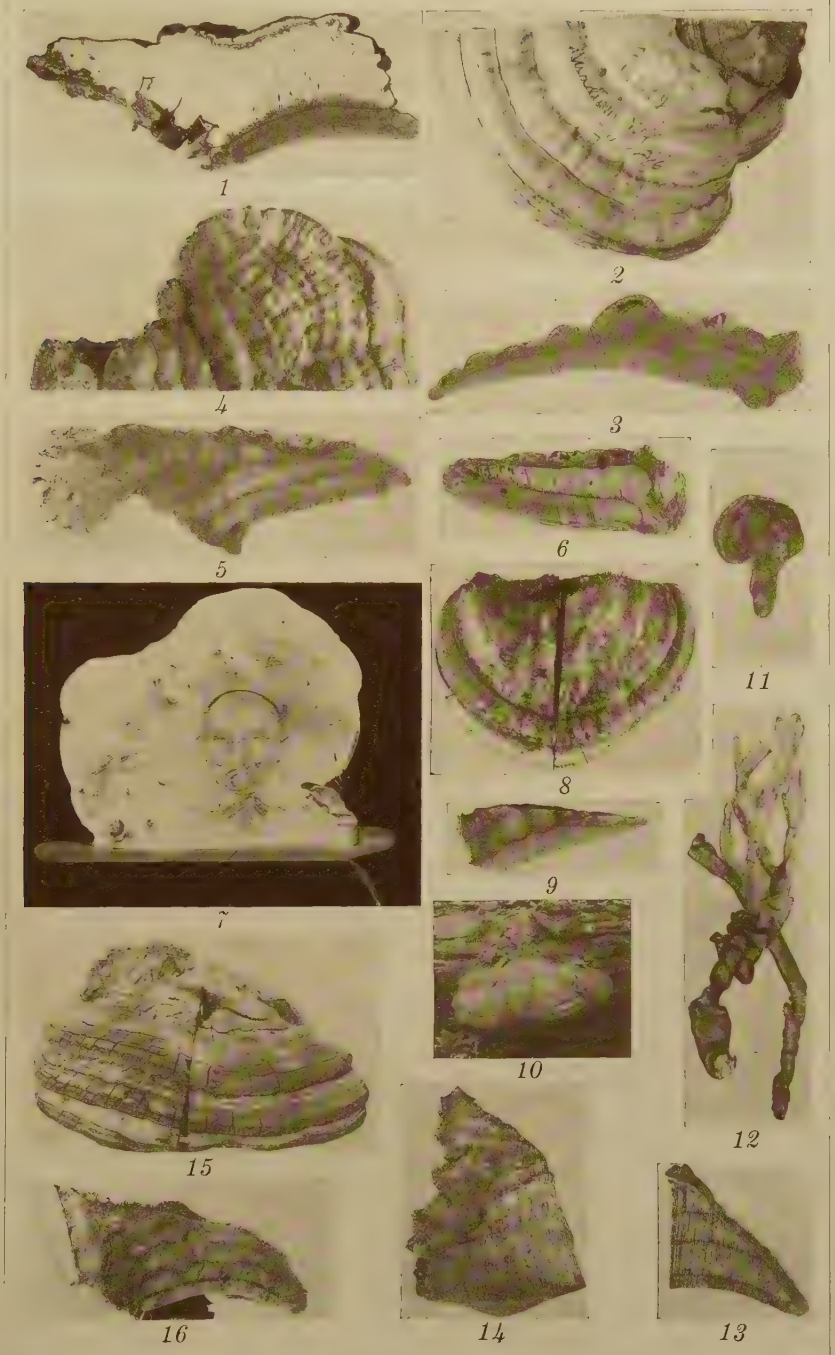


PLATE 1.

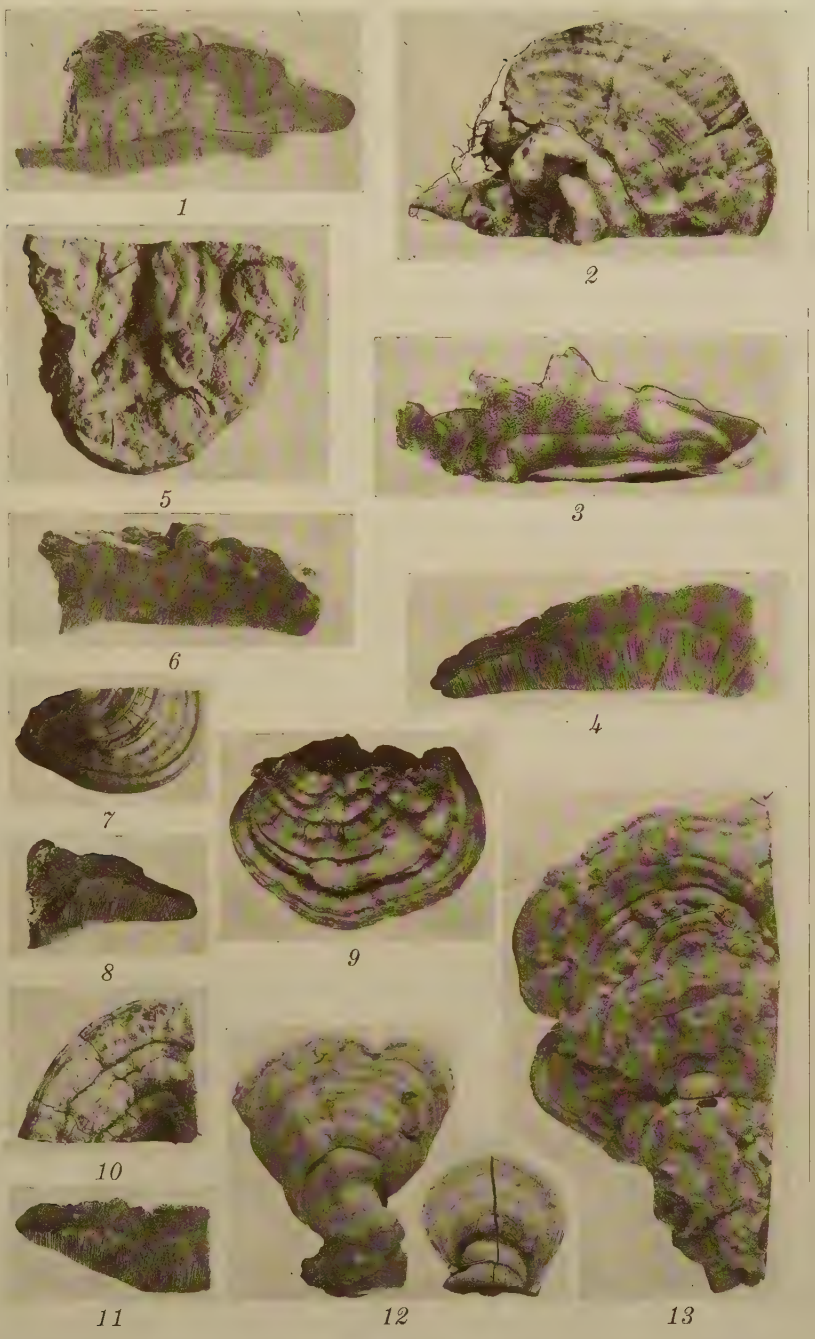
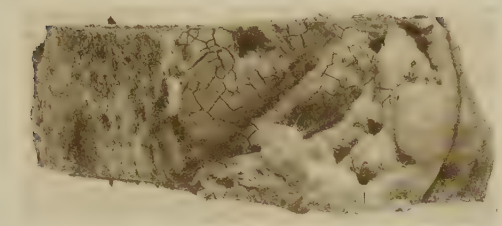


PLATE 2.



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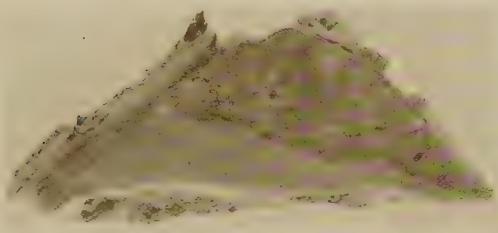

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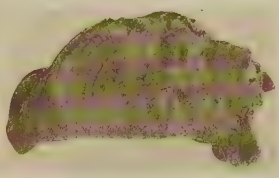

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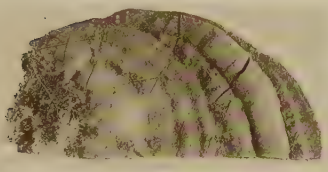

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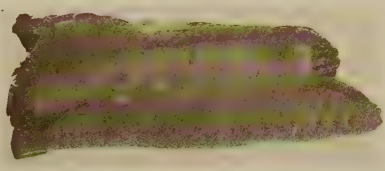

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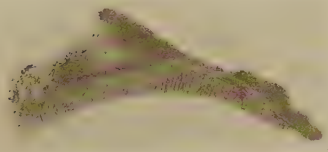

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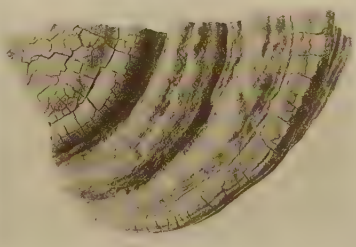

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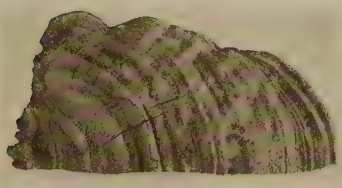

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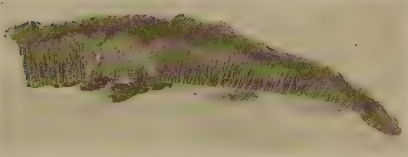

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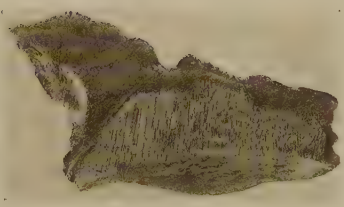

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PLATE 3.

PLATE 4.

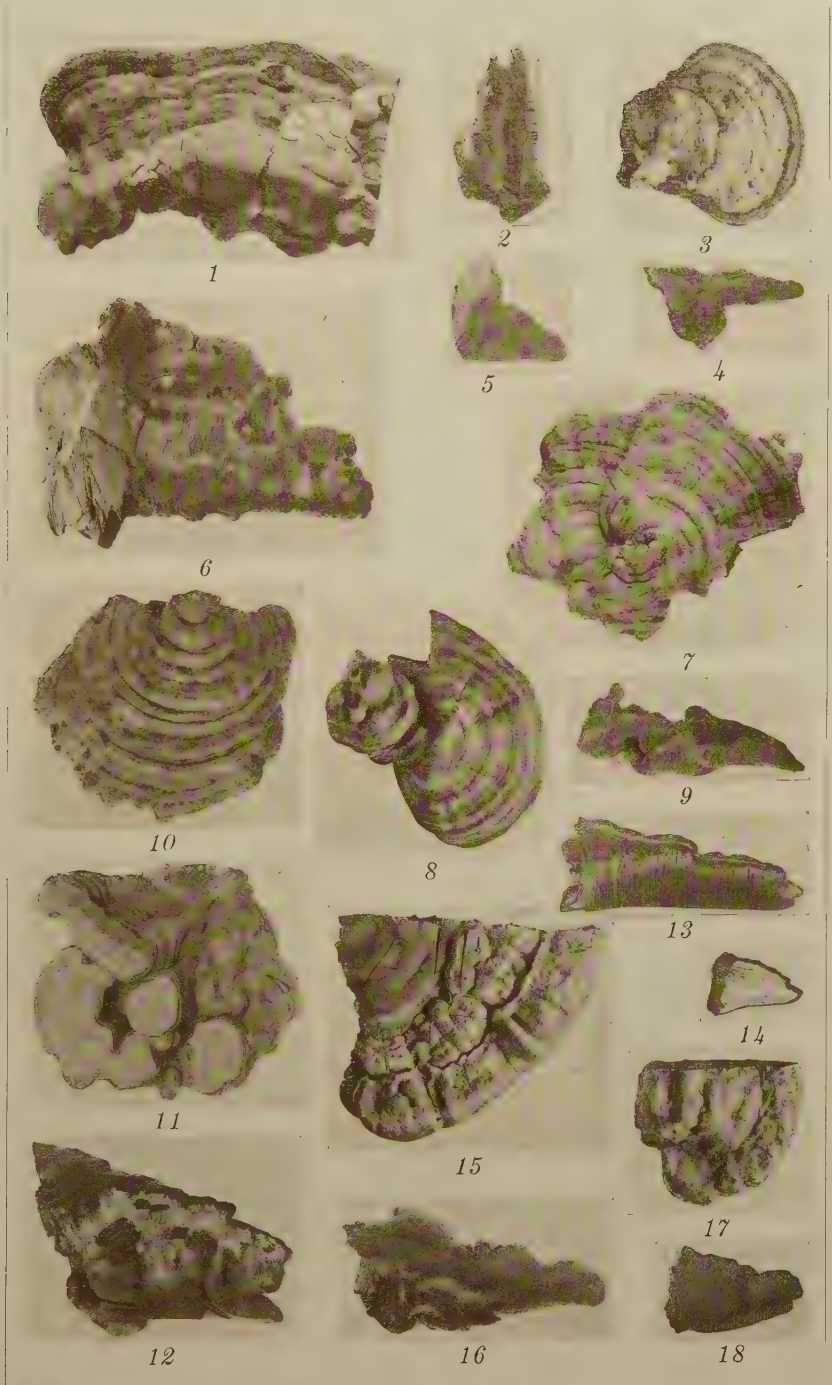
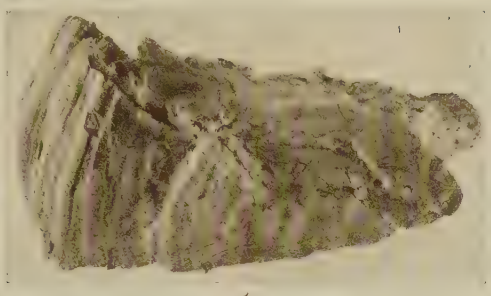


PLATE 5.



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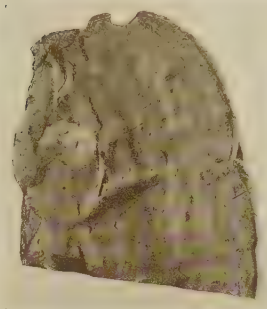

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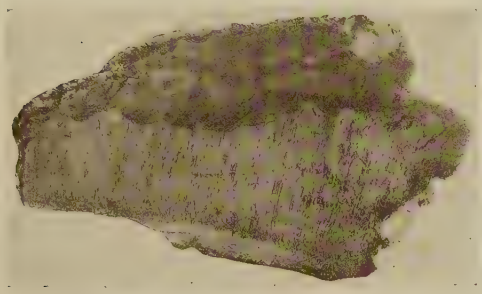

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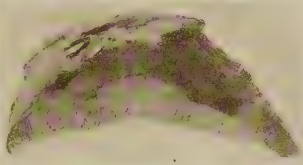

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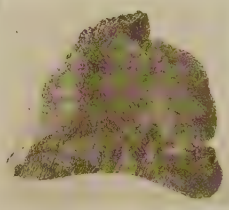

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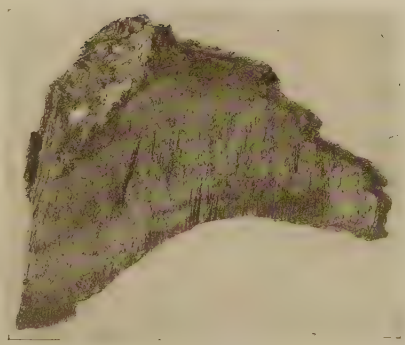

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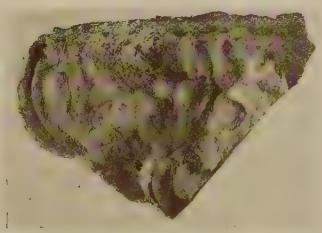

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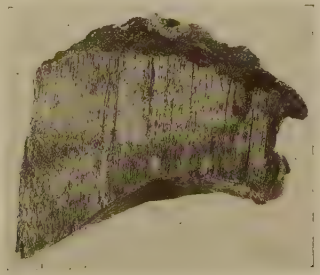

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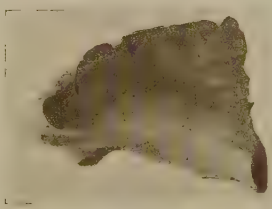

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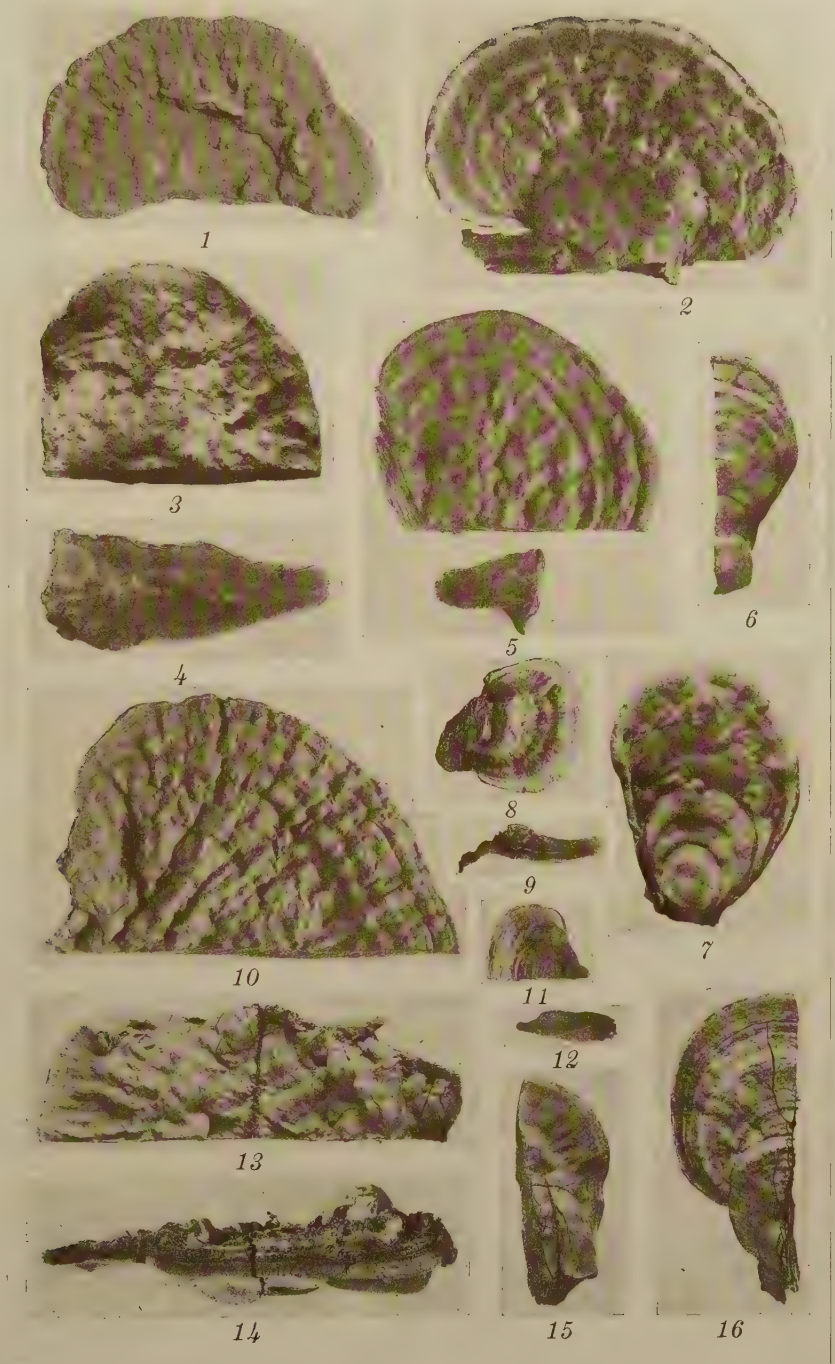
PLATE 6.

PLATE 7.



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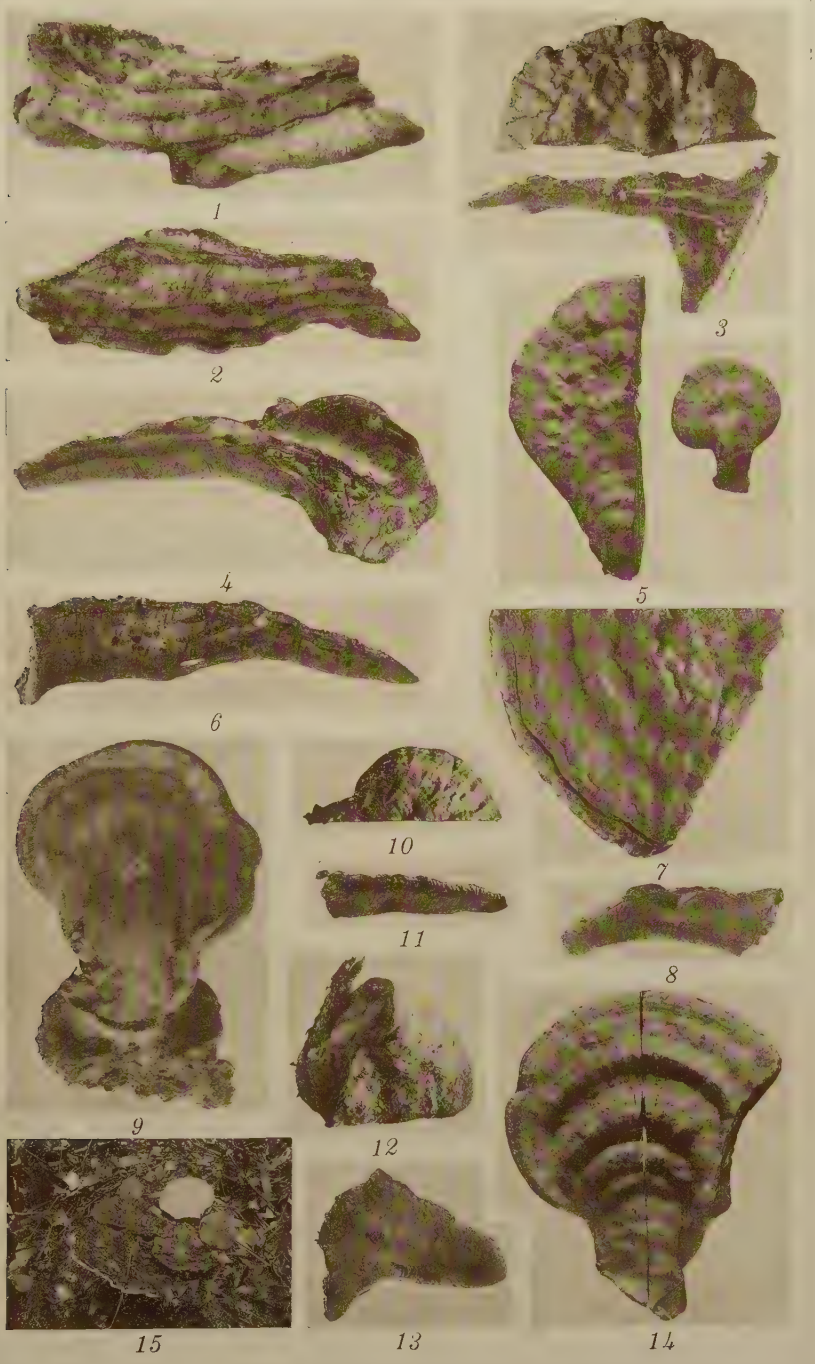

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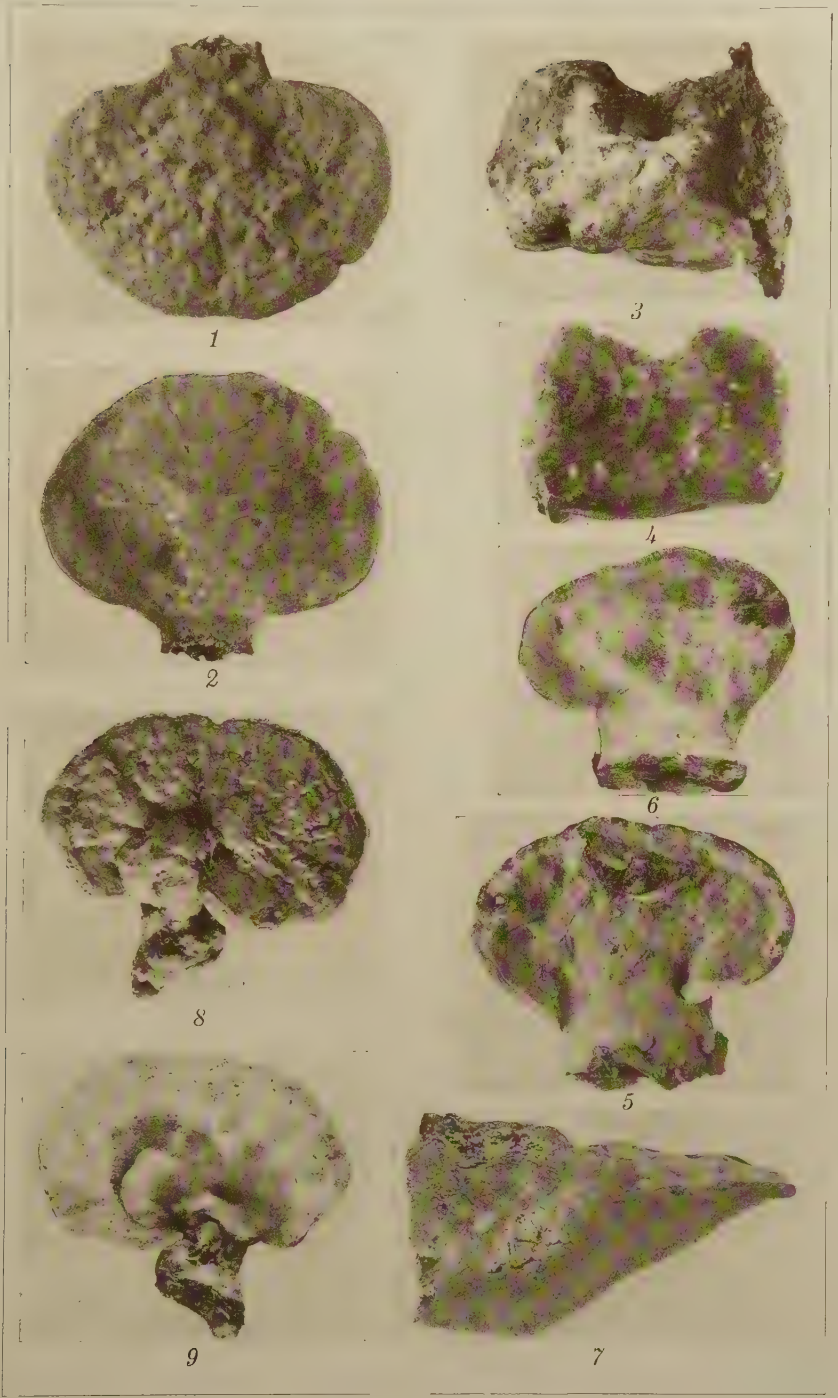

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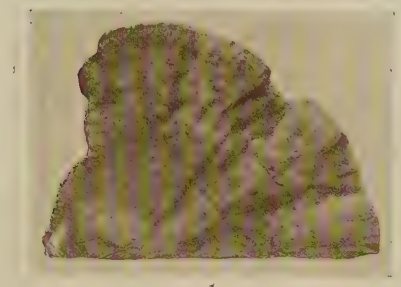

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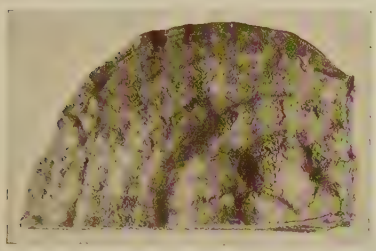

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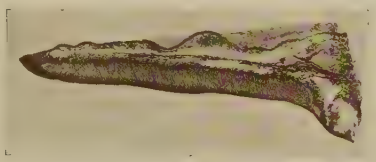

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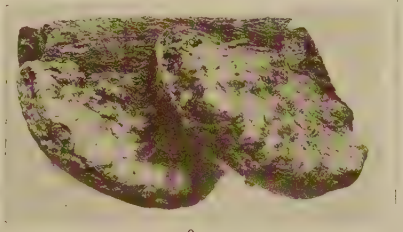

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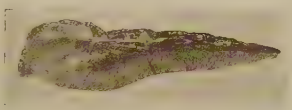

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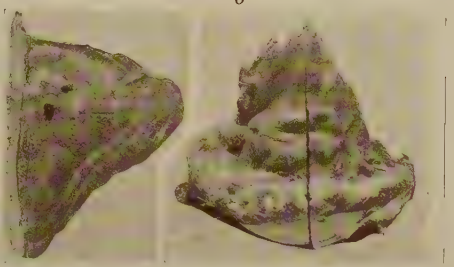

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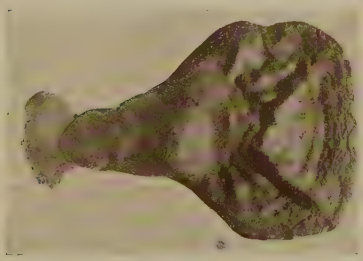

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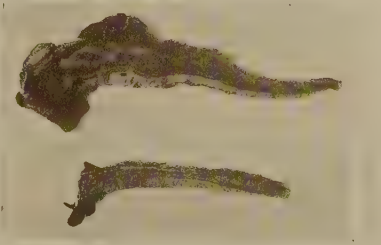

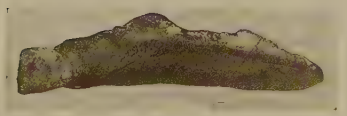

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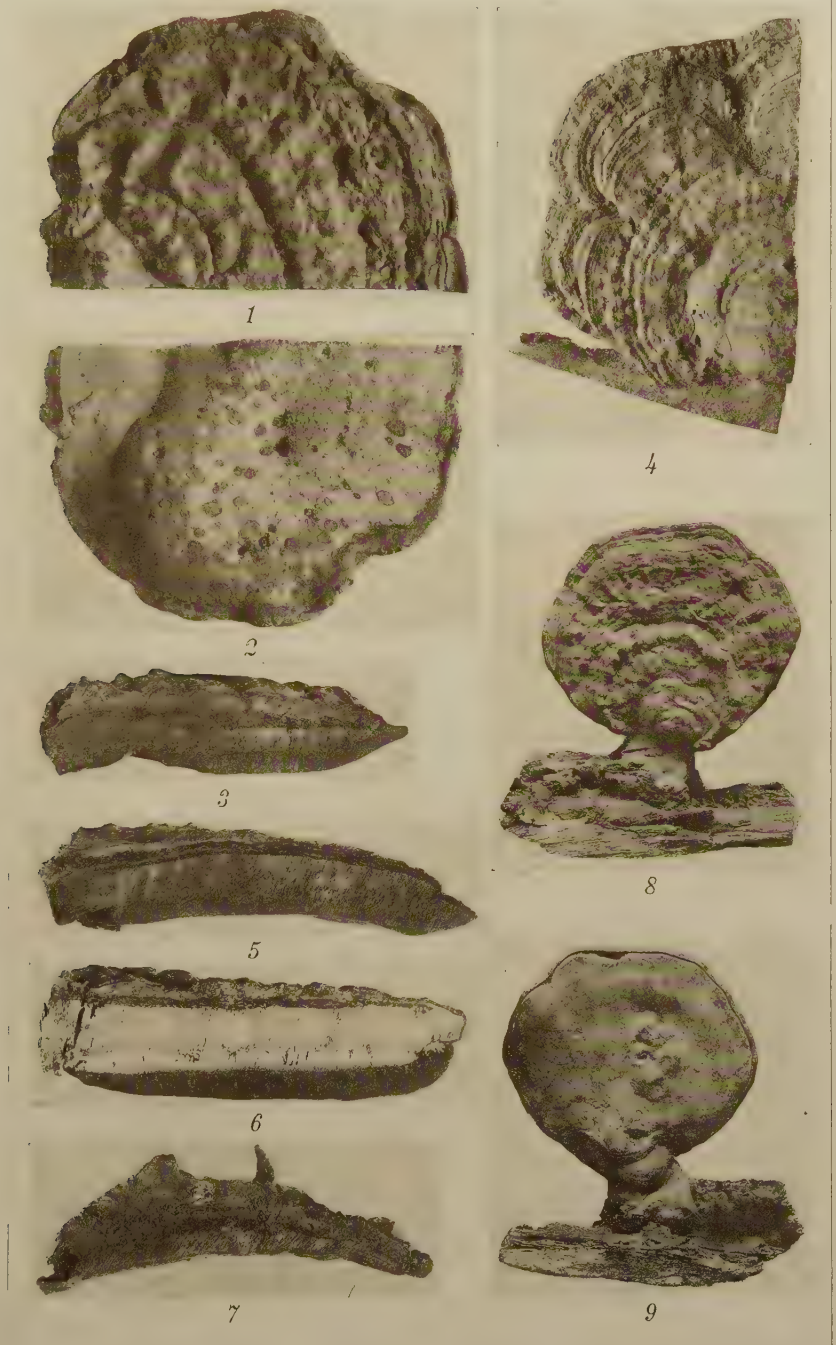

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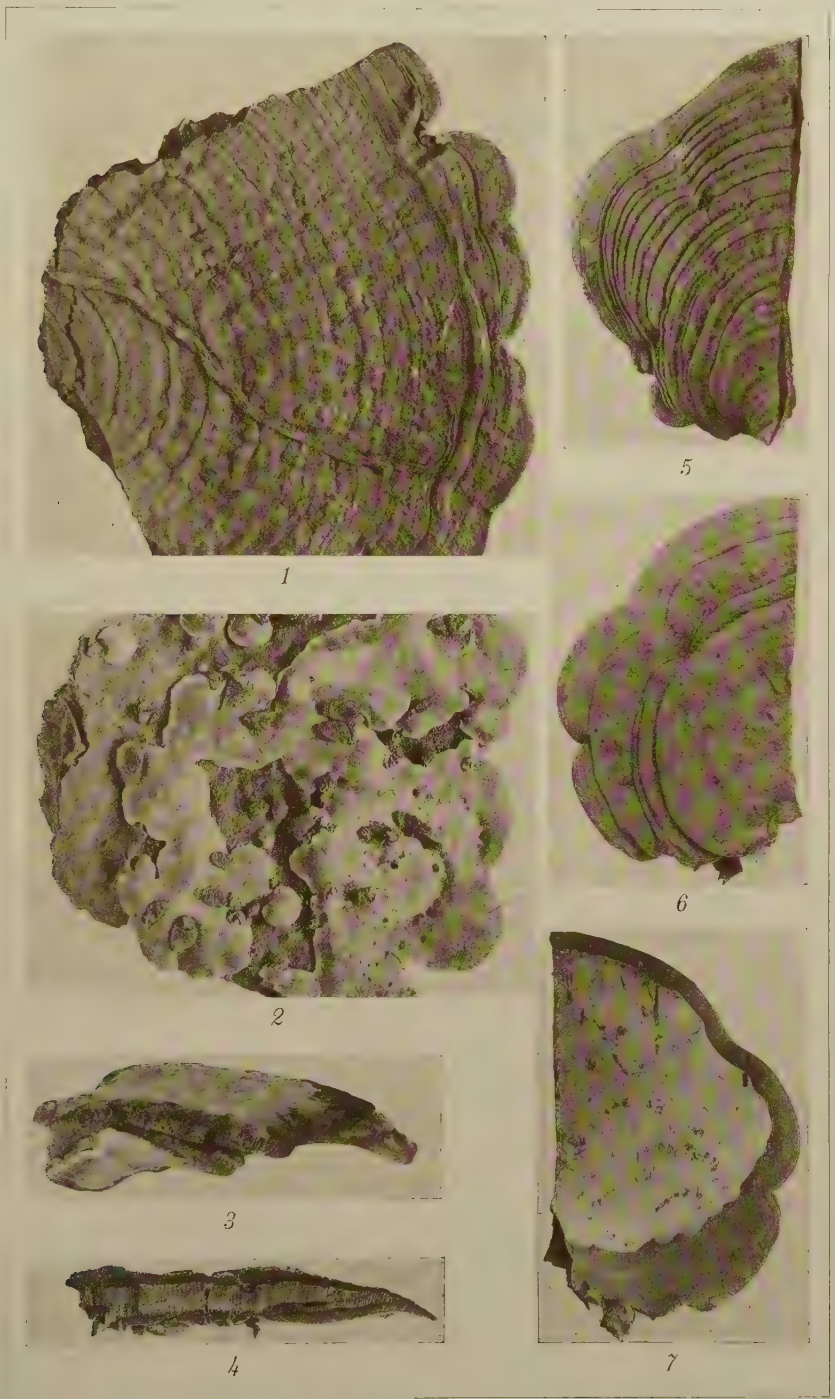

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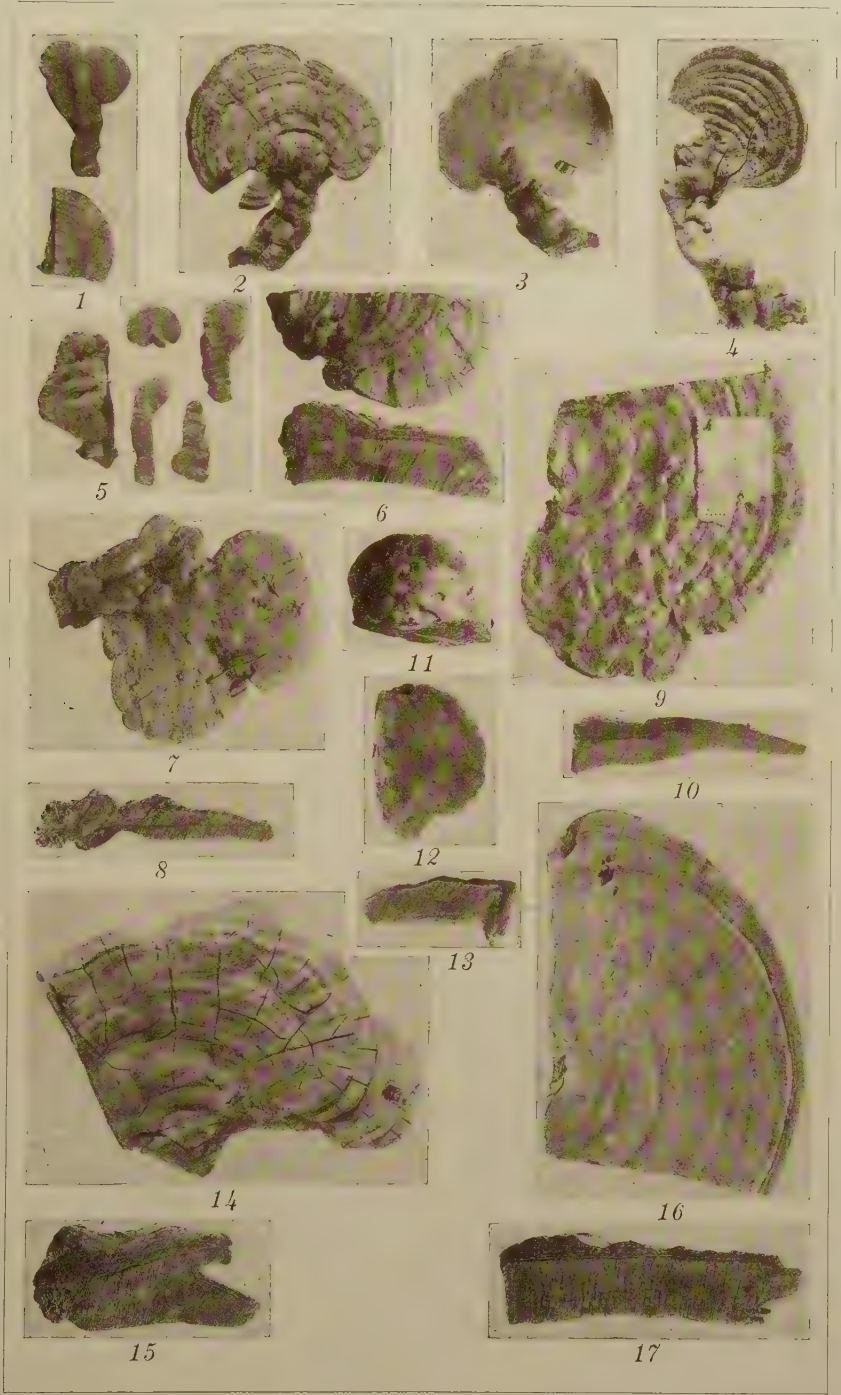

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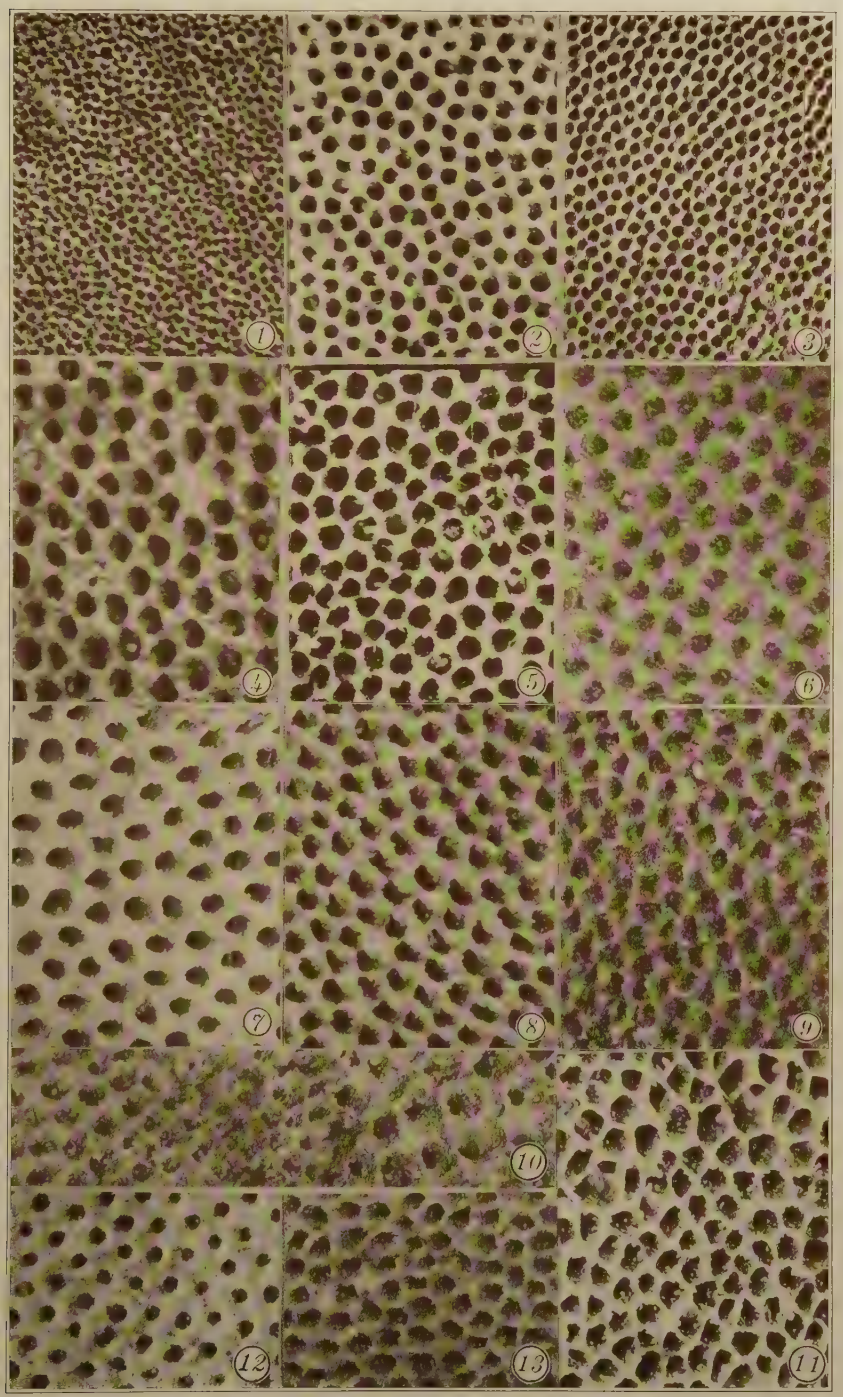

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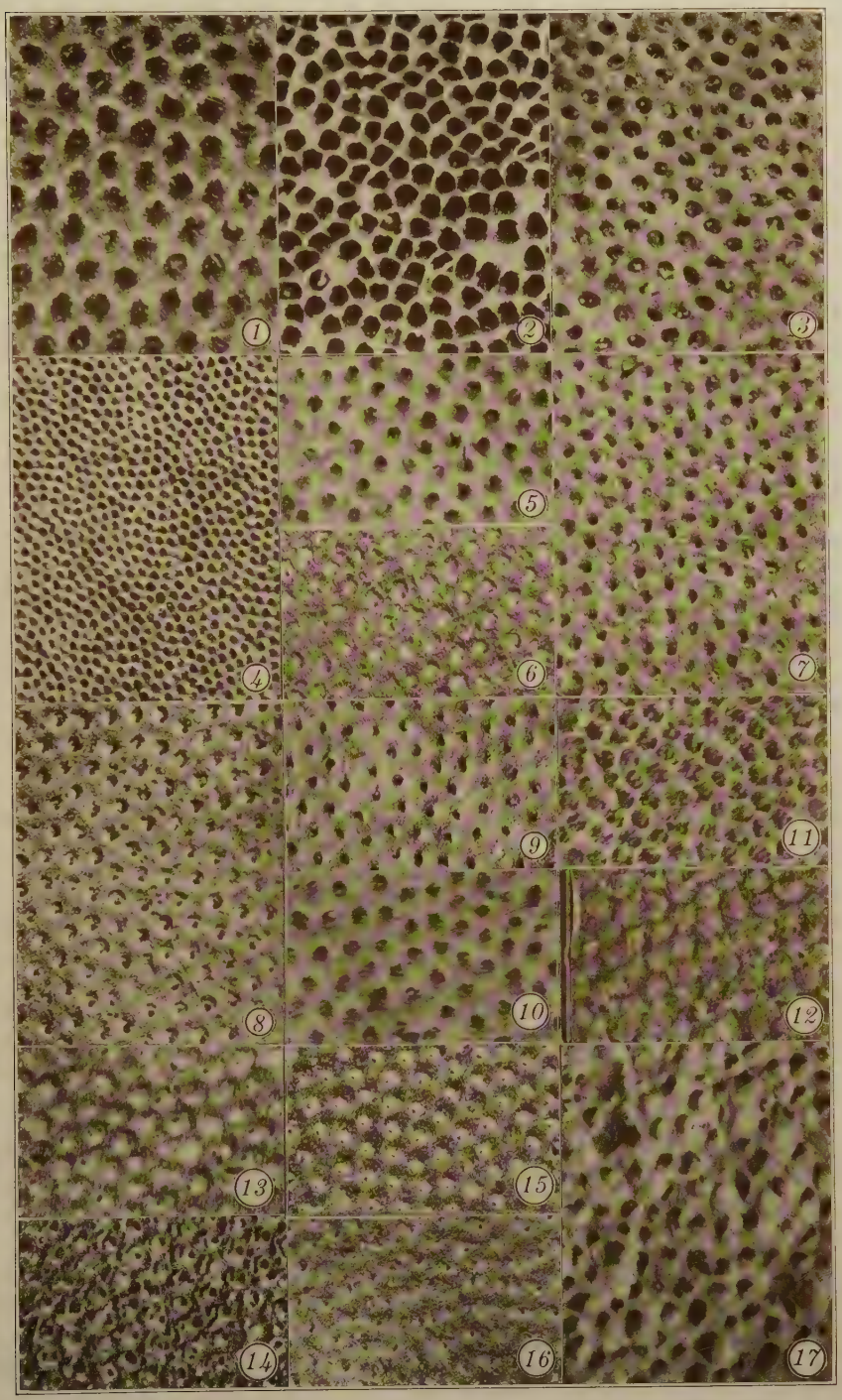

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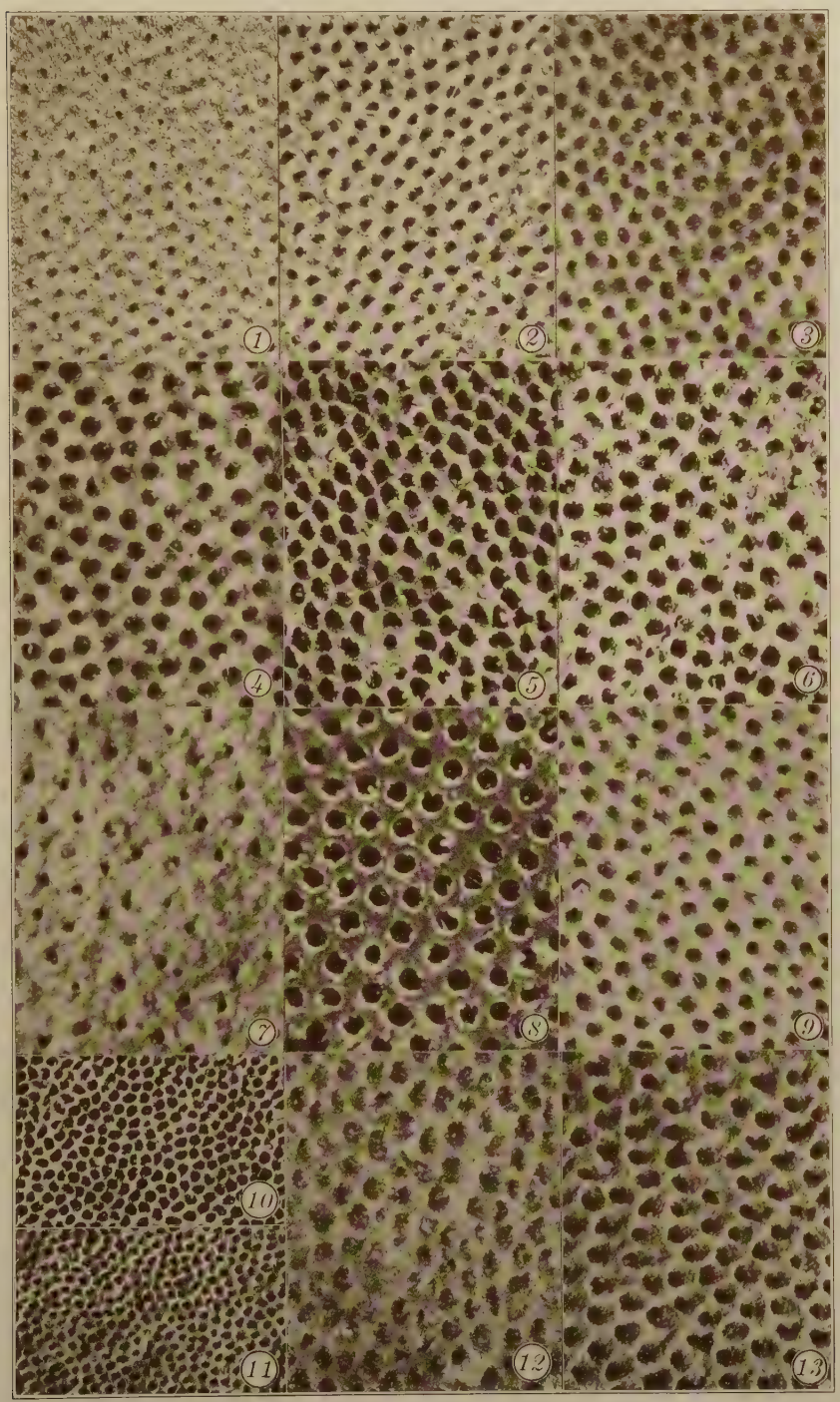

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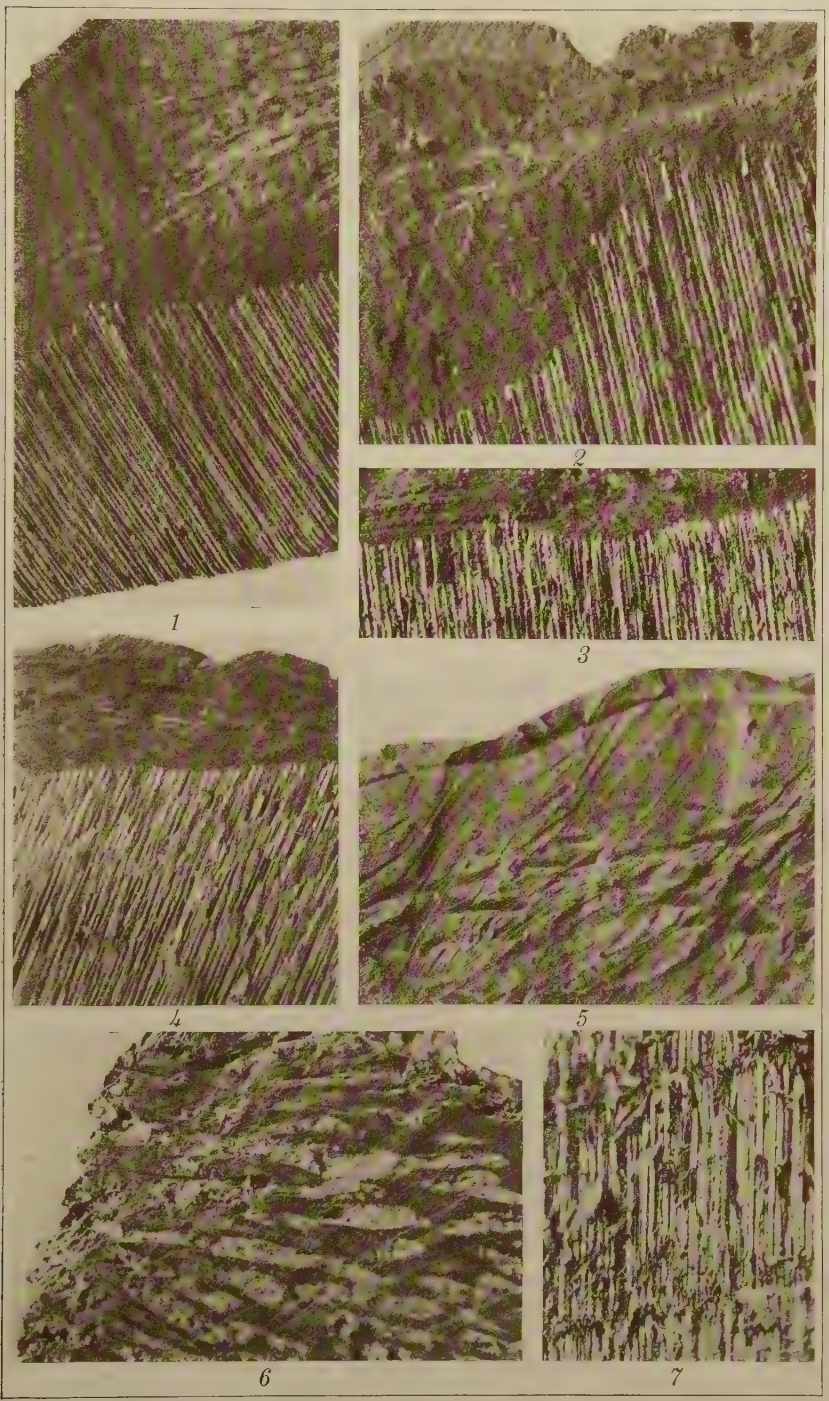

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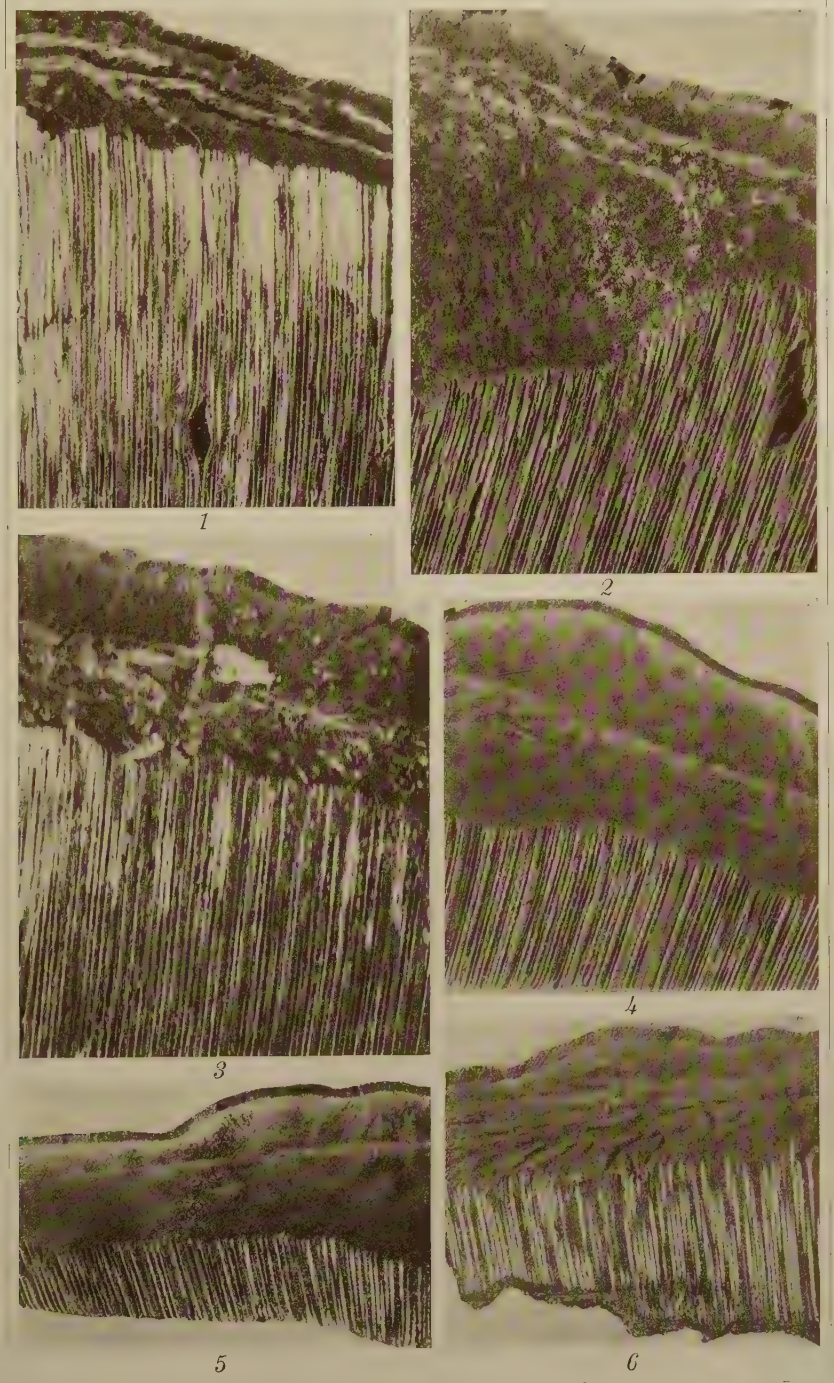

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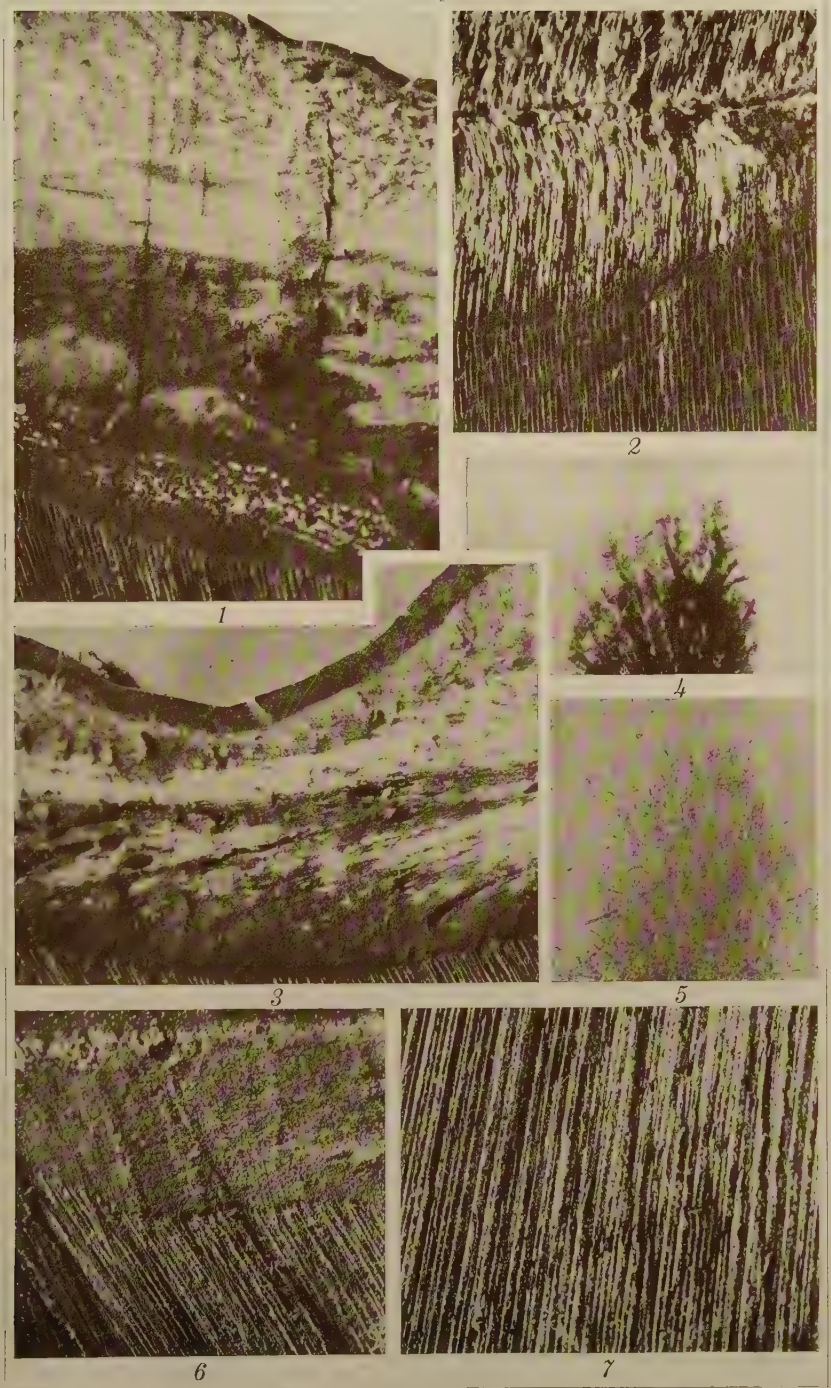

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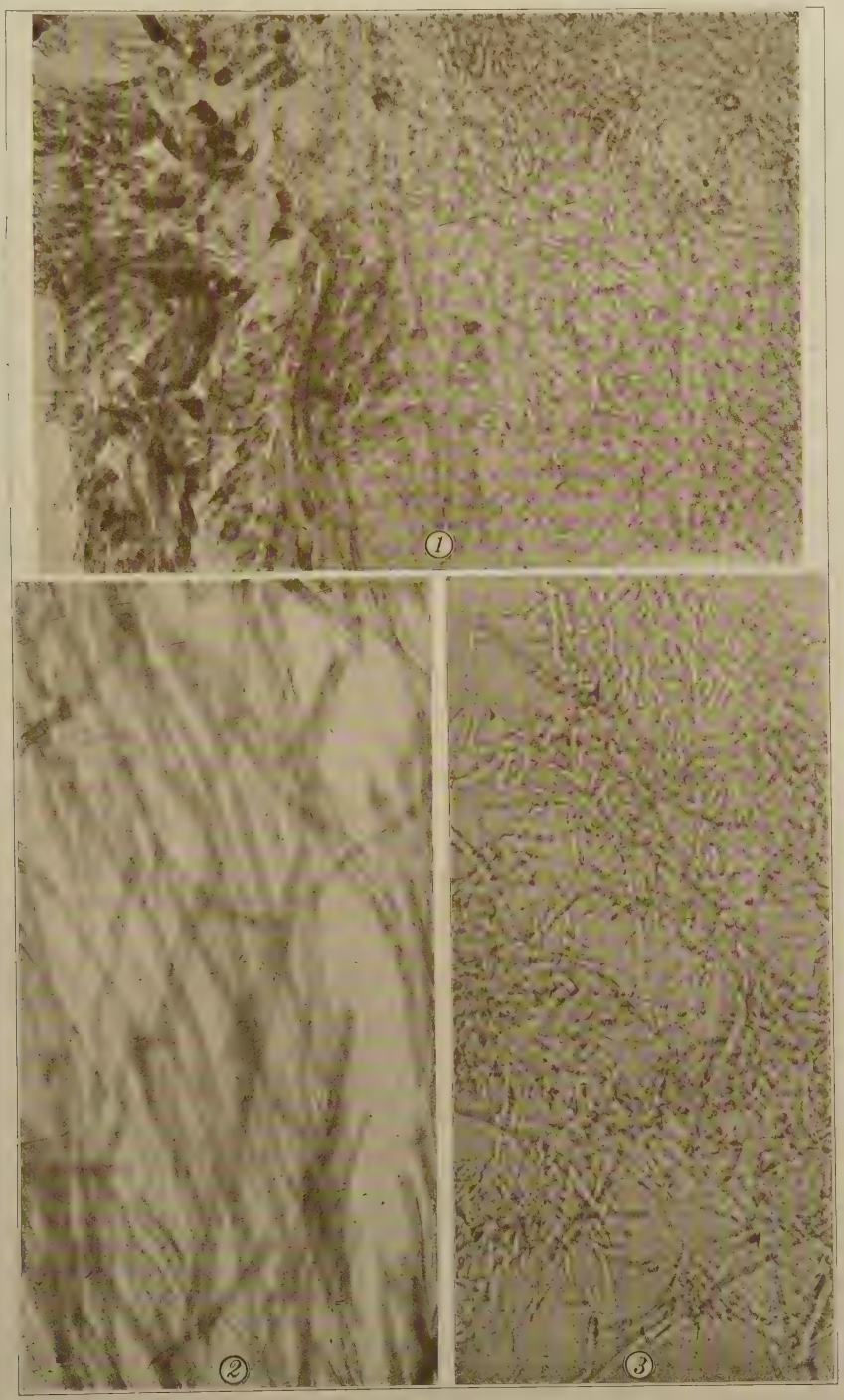

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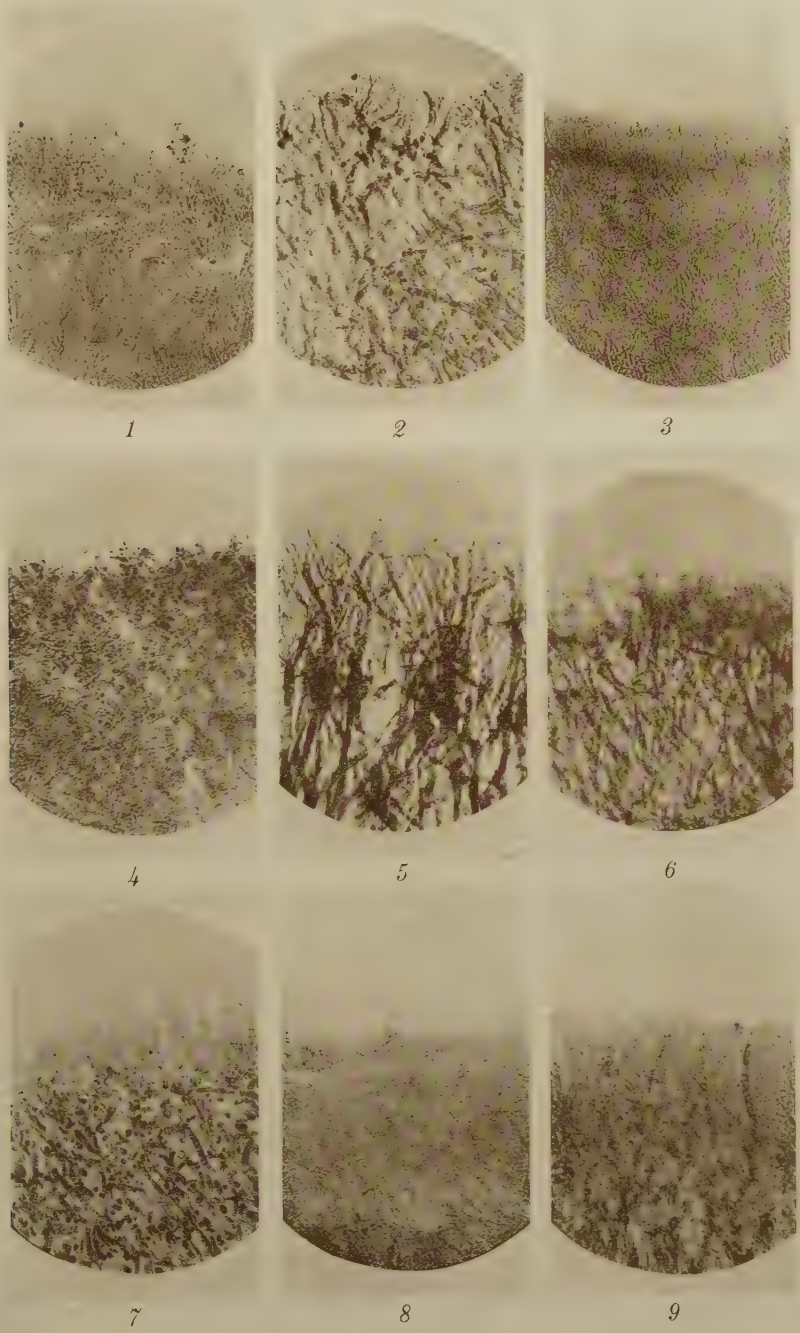

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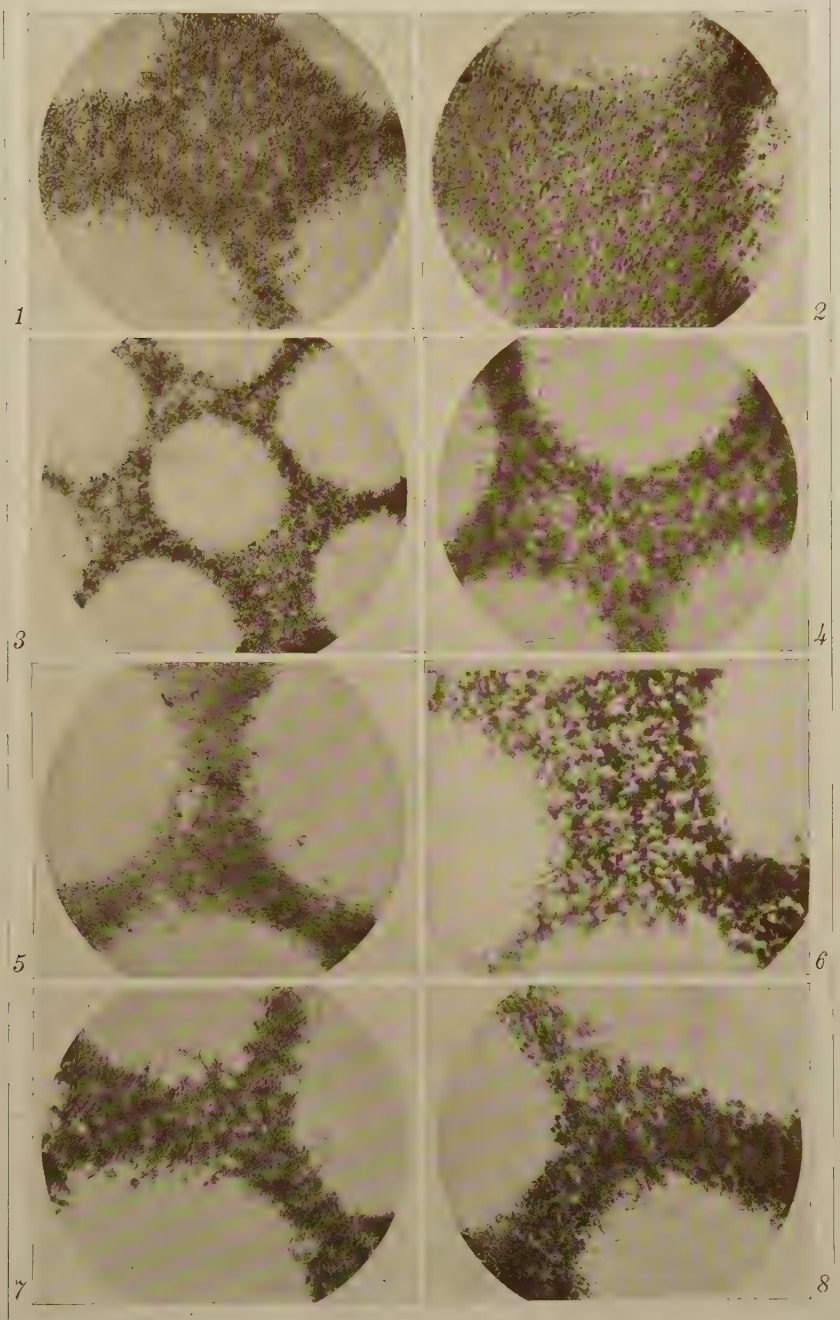

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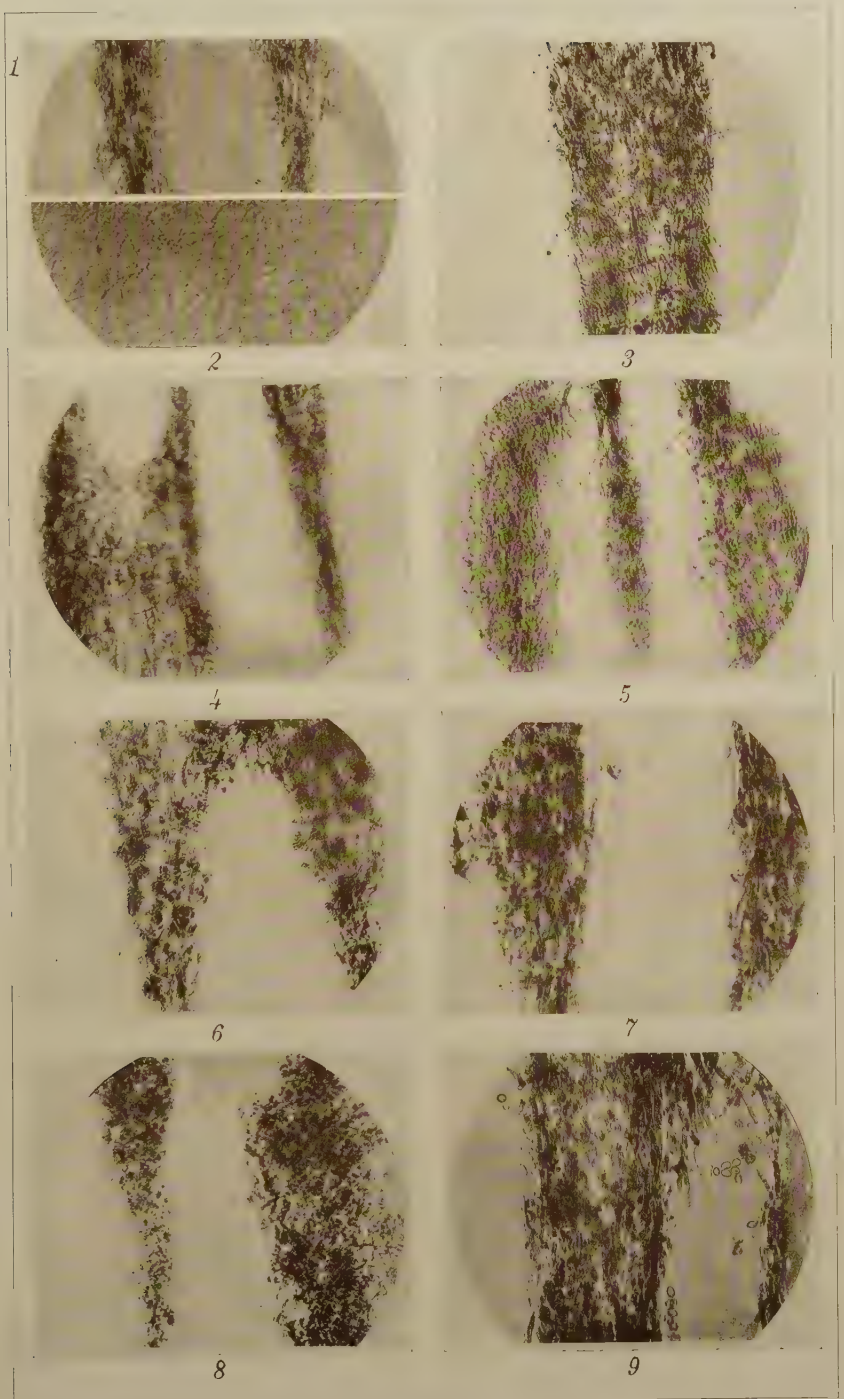

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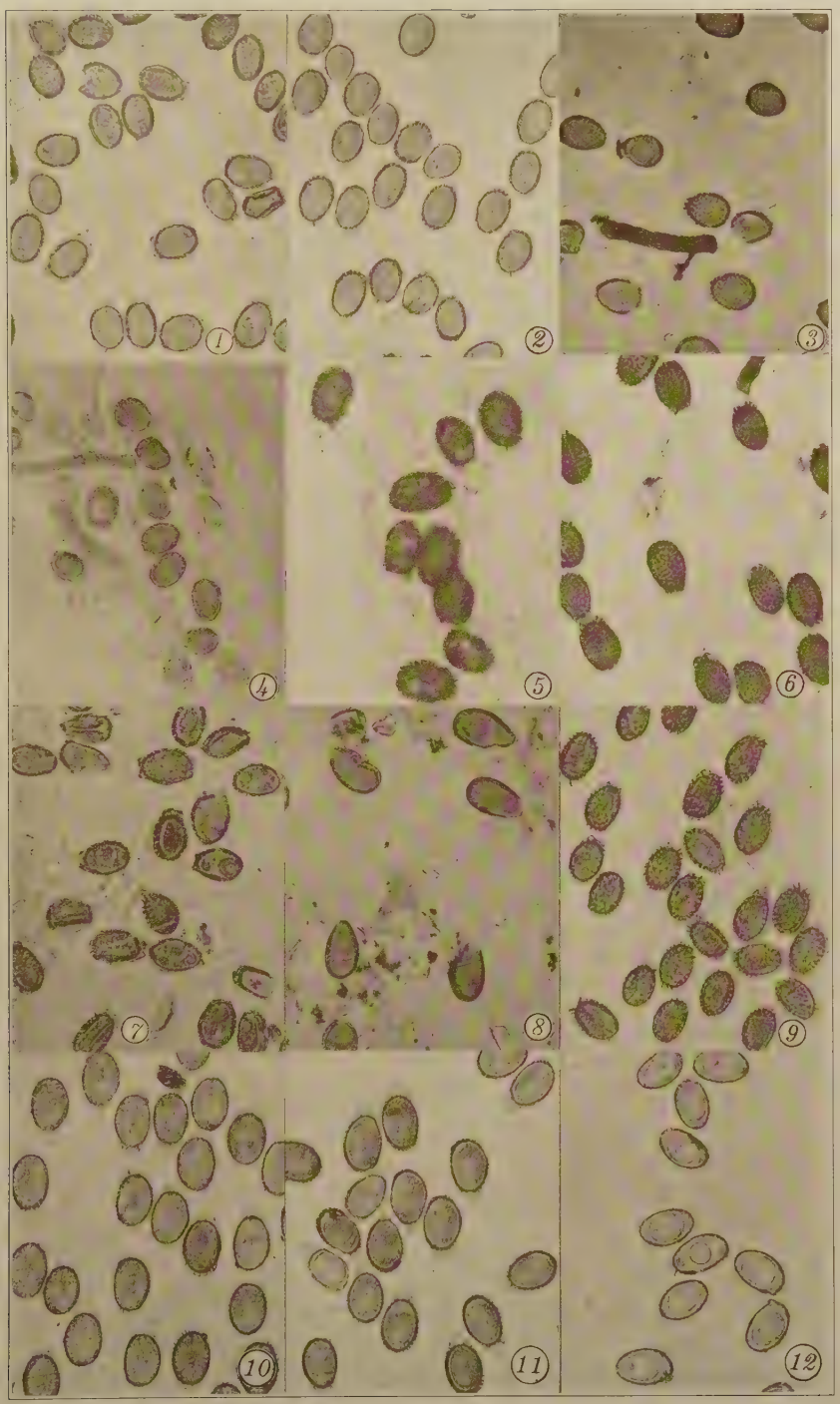

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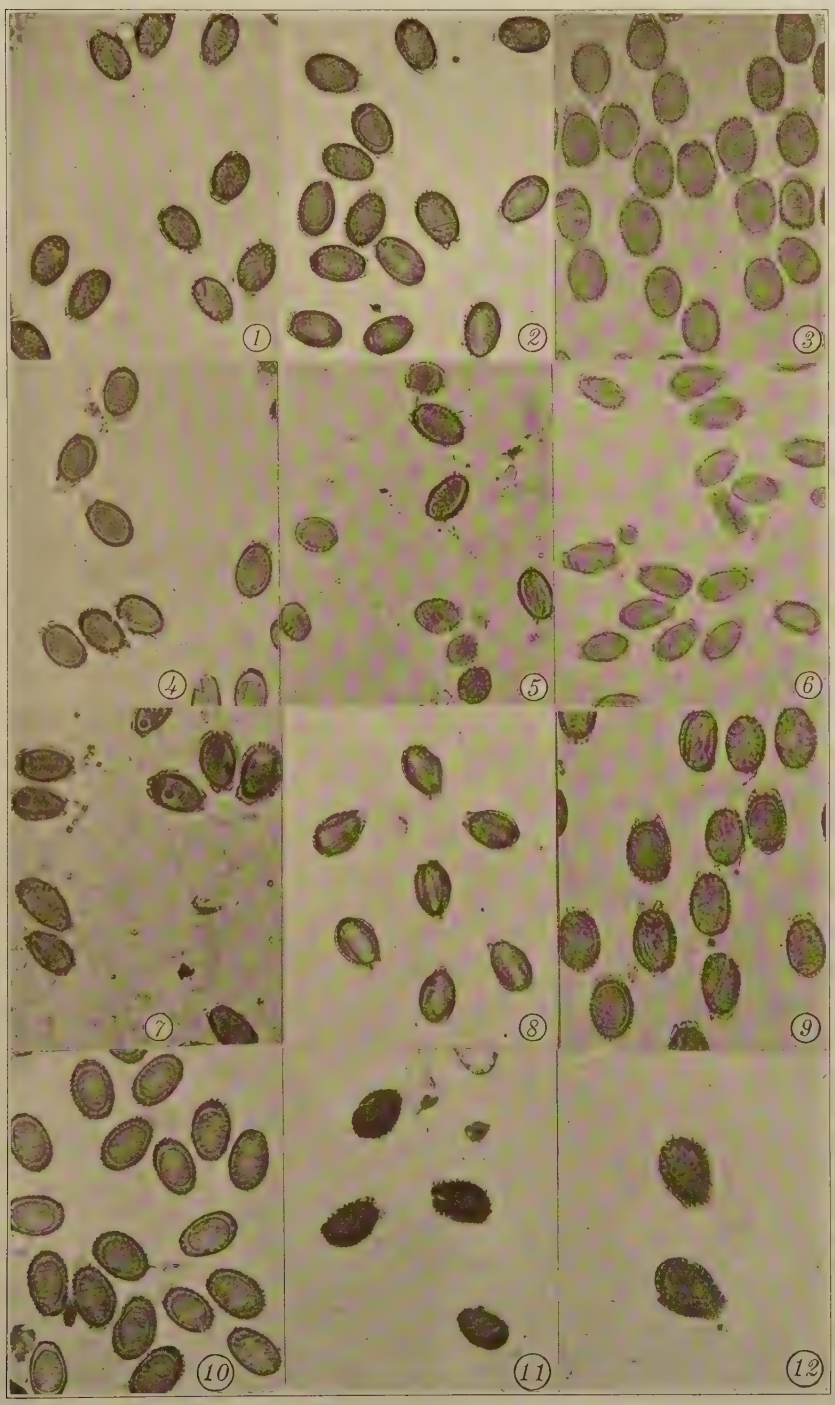

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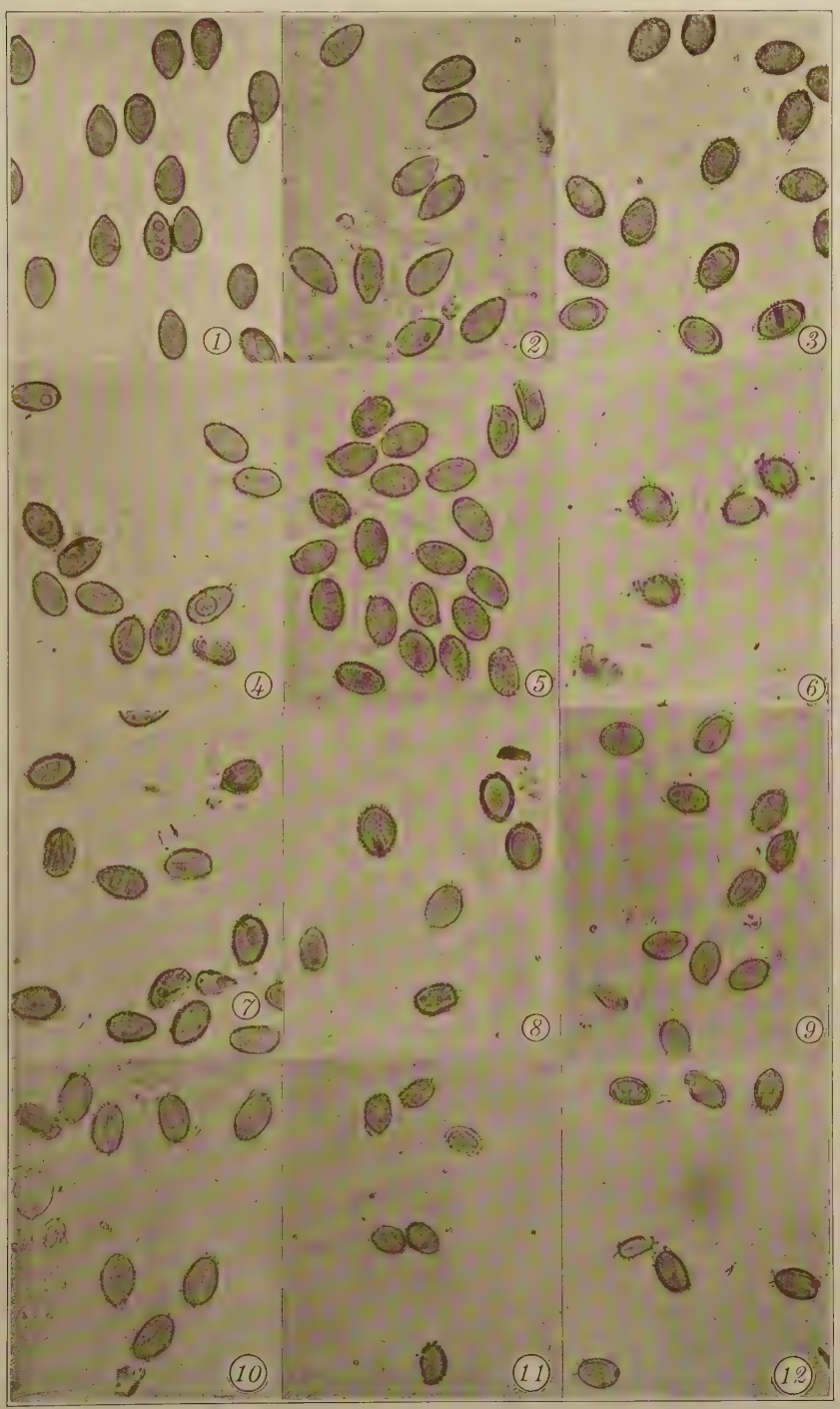

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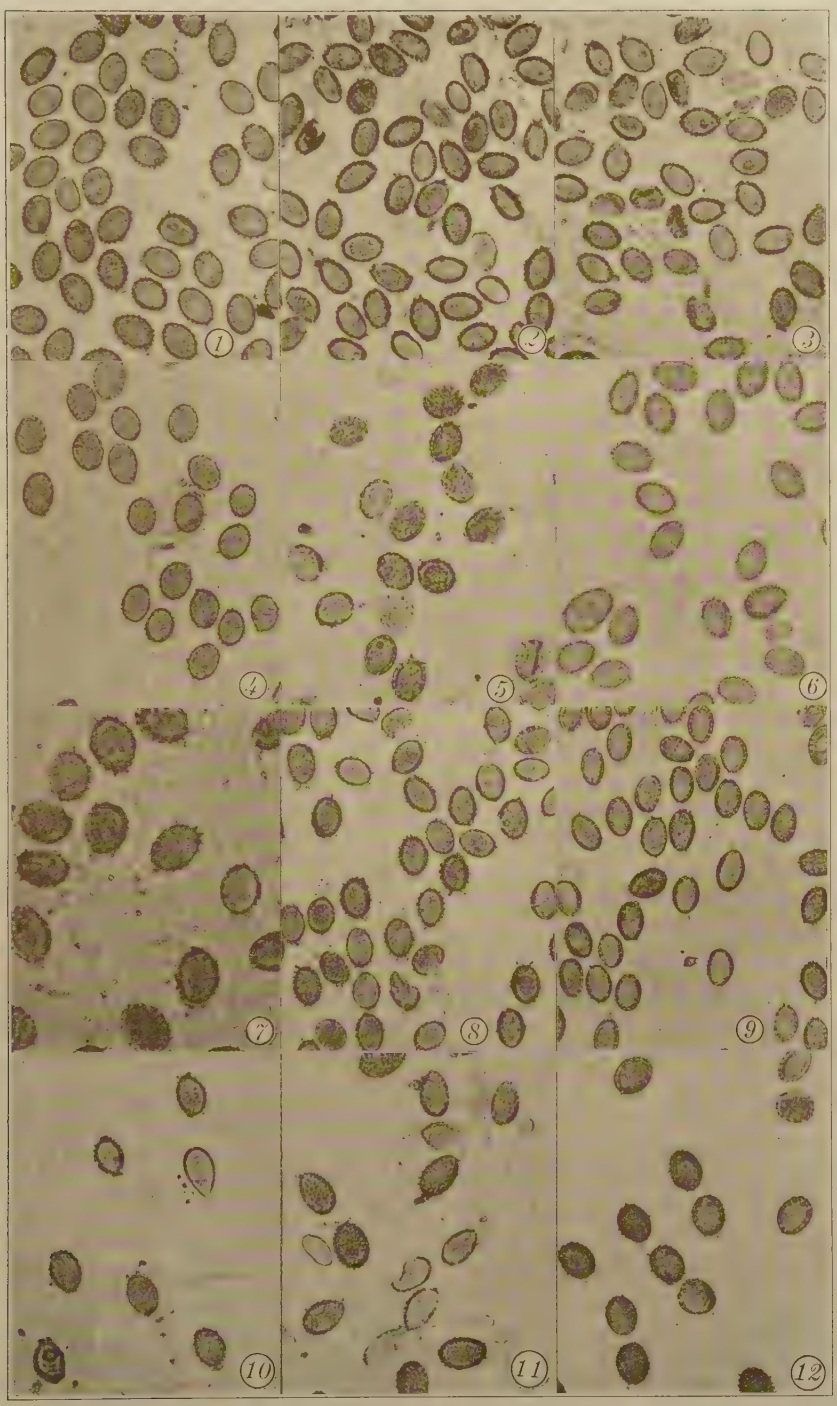

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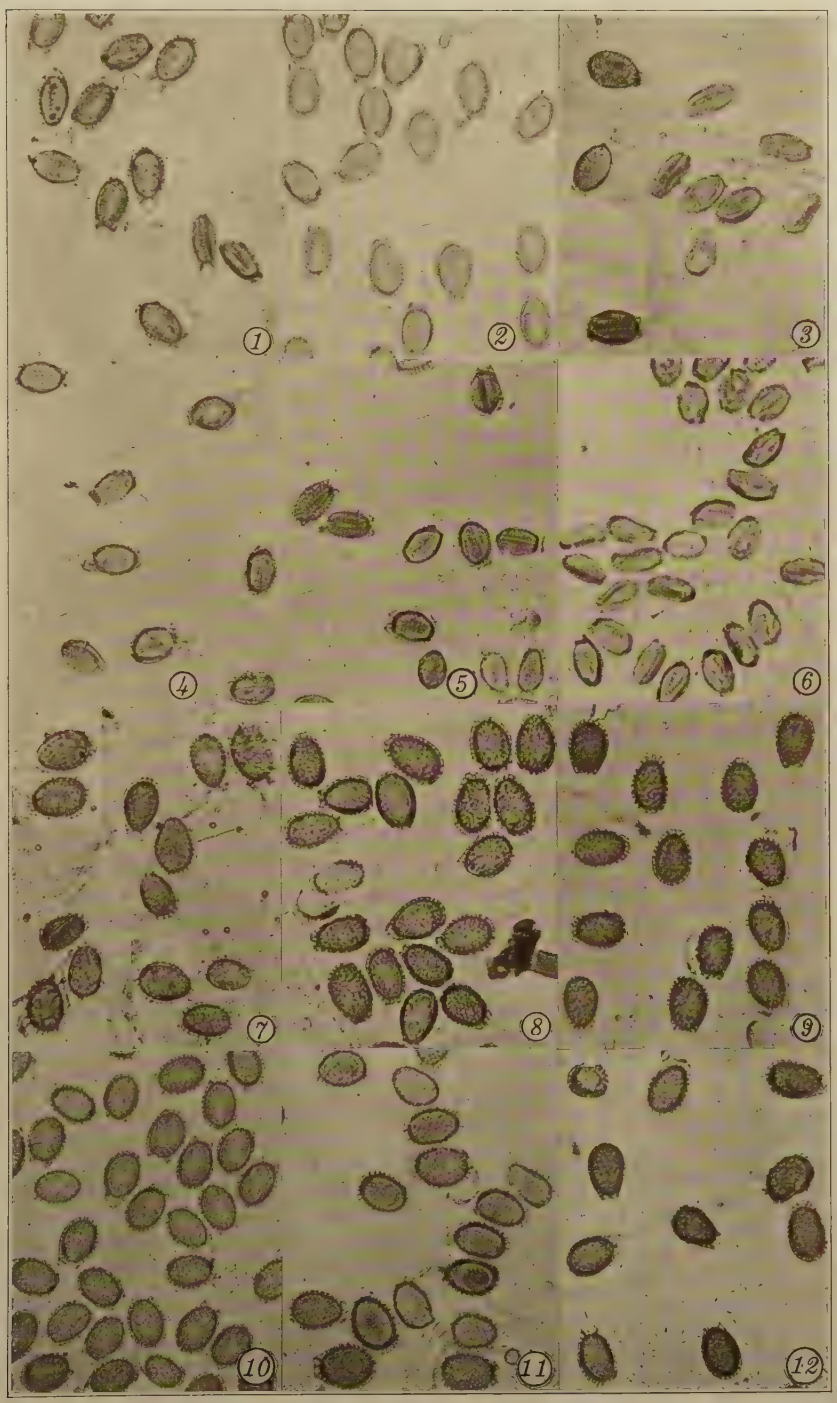

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